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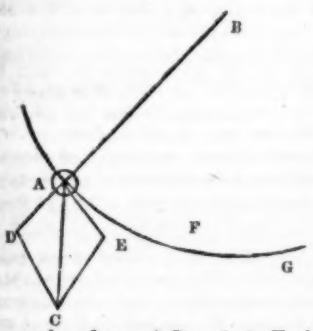
DR. LARDNER'S LECTURES.

(Continued from p. 198.)

The next thing to be considered is a very important one, viz: the centre of gravity. If there be several points separately attracted by the force of gravity, the different forces may be supported by one fixed point; and if these several forces act on different parts of a body, this certain point is one which has the same effect as those forces, and this point is called the centre of gravity. In considering the mechanical effect of a *solid* body, the whole of it, except that one point, may be supposed to be quite deprived of weight, whilst the whole weight or gravity is concentrated in that one point.

One of the properties of this point is, that it always descends, or endeavors to descend, in the straight line perpendicular to the surface of the earth or as near that line as possible. Let A represent a body, fastened by a rod or string to the fixed point B. Now the line in which this body would fall, were it at liberty to do so by its own gravity, would be A C; but this force may be resolved into

Fig. 24.



the two other forces A D and A E, being the sides of a parallelogram, of which A C is the diagonal. But the force A D only stretches the rod, therefore AE is the only force which tends to produce motion, and the body will consequently fall in the curve AFG. If the direction of the rod AB be supposed to be more perpendicular than before, it is evident that the side AE will be much less, therefore the body will move with a much less velocity than before; and the velocity can be proved, in like manner, to be less and less, until at last, when the rod is exactly perpendicular, there will be no motion, the only effect being that of tension. Consequently, if the centre of gravity be not directly under the point of suspension, the body will descend, or endeavor to descend, until it is exactly under that point; and this position is one of equilibrium.

But there is another state of equilibrium; viz: when the centre of gravity is *directly over* the point of suspension.

If the body be supposed to be in the *former* position, it is evident that any motion given to it must cause the centre of gravity to ascend; but one property of gravity being, as before stated, that it will always descend (or endeavor to descend,) the body will return to its former position. Now it is different in the *latter* state of equilibrium: for there, the least motion given to it will throw it on one side, when it will descend, and, after vibrating, will settle in the former state of equilibrium called the Stable, while the latter is the Unstable state of equilibrium. However, these are not the exact definitions of the words "stable" and "unstable," as there are instances when they are exactly opposite, which would be the case supposing the body to be a small balloon filled with gas. But the true criterion for distinguishing the different states is this: the state of equilibrium is stable, when, any disturbing force being applied to it, the body will return to its former position; and it is unstable, when it will move into the other state on being disturbed.

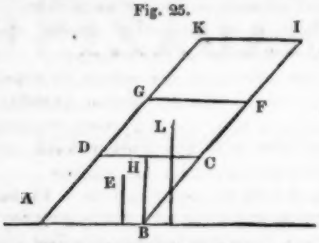
(The manner of finding the centre of gravity of a body, is too well known to need description.)

When a body rests on a base, its stability depends on the line of direction falling within that base.* Thus let ABCD be

* The line of direction is a line drawn from the centre of gravity perpendicular to the horizon.

a parallelogram, resting on the base A B.

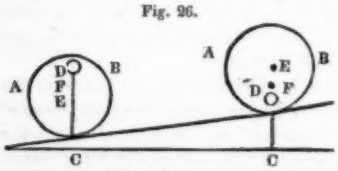
Fig. 25.



Now the line of direction, drawn from the centre of gravity E, falls within the base; therefore the body will stand securely. Now suppose another parallelogram, DCFG, be placed upon the former one, which together will make the figure ABFG; the line drawn as before, from the centre of gravity, H, will fall exactly at the point B. This position may be called the boundary between the stable and the unstable states of equilibrium: for although it may stand on its base, yet, on the slightest force being applied to it, it will fall over. Again, let a third parallelogram, GFIK, be applied, which will raise the centre of gravity to L: the whole figure ABIK, will then fall over, and the line of direction will fall beyond, or outside, the point B, of the base.

There are some experiments which may be shown, by which the centre of gravity may seem actually to ascend rather than descend. It is a general idea, that the centre of gravity lies in the centre of magnitude; and this is true, when the body is composed of the same substance throughout. But let ABC be a circle of any light substance, as

Fig. 26.



wood, &c.; and let there be part of it, as a hole D, filled with lead. Now the centre of gravity has been moved to F, in consequence of the weight D being applied, while the centre of magnitude is at E, the centre of the circle. If the body be so placed that the centre of gravity be above the centre of magnitude (or rather a little to one side), it will roll towards that side, even although the plane on which it rolls be so inclined as to form a slight ascent. Yet, notwithstanding that the centre of gravity may *appear* to ascend, yet in reality it descends, as may be thus proved. Measure the height of the centre of gravity from the horizontal line CC, also its height when it shall have arrived at the top of the plane; at which place it will be found to be lower than it was at first, although the centre of magnitude is higher.

The centre of gravity is not always a real point in a body: thus that of a ring is at an imaginary point, as is also that of an arch.

When a body which rests upon a base is liable to disturbance, its stability depends upon the position of the centre of gravity. Let ABCD be a parallelogram, the centre

Fig. 27.

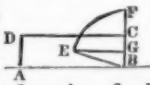
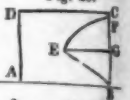


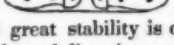
Fig. 28.



of gravity of which is at E: draw the line EB, and with B as a centre and radius BE, describe the arc EF: draw FB perpendicular, and EG parallel to the horizon. Now to turn this body over on the point B, it is evident that the centre of gravity must be moved from E, along EF, or, what is the same thing, must be raised the height of GF. Again, let the body be twice the height, but on the same base; let ABCD be the figure, (see fig. 28.) draw lines in the same manner as the last, when it will be seen that the line GF is shorter than in the last case; consequently it will be more liable to turn over. It may be shown in exactly the same way, why wagons, &c. are more dangerous when the load is placed high than when it is lower.

It is also on this principle that the stability of the different positions of the human body depends: the degree in which it exists may be determined by drawing lines joining the toes and heels of the feet. Thus, it is

Fig. 29.



evident that great stability is obtained in a sideways or lateral direction, while there is very little in the opposite one. In the next

Fig. 30.

there is quite the opposite effect obtained, for there the greatest stability is obtained in a front direction. Different effects are obtained in the two next figures, which will be easily understood.

Fig. 31.

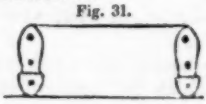
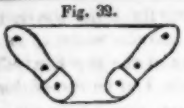


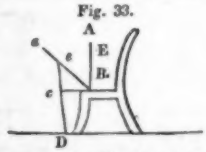
Fig. 32.



All the various inflections of the body are governed by this principle. But there are some curious instances of the effects produced, which may be amusing.

When a person is sitting on a chair, if he attempts to get up, he will find it impossible, if he keeps his body erect; but if he stoops forward, he can easily do so, which may be thus explained. Let A B represent the body,

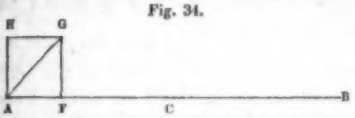
Fig. 33.



Bc the upper, and cD the lower parts of the legs of a person when seated. Now the centre of gravity being at E, it is plain that there is no support for it except the stool; but when he throws his body forward in the direction *Ba*, then the centre of gravity, *e*, is above his feet; consequently, the only force required will be in a perpendicular direction.

It may have been observed, that when a man, a horse, &c. is turning a corner, the body is inclined towards that corner. This is most visible in the feats of horsemanship effected in a ring. Let AB represent the

Fig. 34.



diameter of a ring, round which the horse is to run, and the centre of which is at C. Now when a body is turning round rapidly, there is a certain force generated which is called a centrifugal force; the effect of which is to make the body endeavor to fly away from the centre. Let the line GH be the direction and quantity of that force, then the line of direction of the centre of gravity will be in the line HA. Now by making a parallelogram on the lines GH and GF (GF being substituted for HA), the diagonal GA will be the resultant, and which is the direction of the horse's body.

The same effect is observable in a carriage; which shows the danger of turning a corner rapidly, particularly when the weight is placed high.

A rope-dancer uses a pole, by means of which he shifts the centre of gravity from one side to another, according as he finds himself leaning on the opposite side.

The next subject to be entered upon is the consideration of machinery.

A machine is an instrument by means of which a force, of a determined quantity and direction, can be counterpoised, counteracted, or overcome by another force, whose quantity and direction are known.

Or, it may be described as a means of transmitting a force of a given quantity and direction from one point to another.

Again it is a means of modifying the quantity and direction of forces.

A machine is employed for two purposes, either merely to sustain or absolutely to move a weight. First, if it is required to sustain a weight, the effect must be, that equilibrium is to be produced. In sustaining a weight by a power, certain parts of the weight are thrown on certain fixed points: thus it is the fulcrum of a lever that supports both the weight and the power. It is a common opinion that a small weight can (by machinery) be made to balance a larger weight: but this is not true, for both the weight and the power are thrown upon the fulcrum; consequently the weight is balanced by the fulcrum and the power.

But if the machine be required to move or raise a weight, it is more difficult to explain. Suppose there was a block of stone weighing 20 cwt. to be raised by a weight of 1 cwt.: if the large block be divided into twenty smaller ones, it is evident that (each piece being equal to the small weight) the whole block could be raised by this small weight, taken separately. Now this is the exact use of a machine; viz. a contrivance for overcoming gradually what cannot be done altogether.

The present object is to examine the varieties of contrivances by which these effects are produced; but great as their number is, they may be all reduced to three classes, although they are often divided into six or seven.

The first class of machines comprehends a solid body, capable of turning on a fixed axis. There are several varieties of this class; the most simple of which is the lever, as also the wheel and axle, the capstan and windlass, together with all combinations of wheel-work.

The second class is the rope or cord; this is commonly called the pulley: the objection to which word is, that the mechanical efficacy does not reside in the pulley but in the rope.

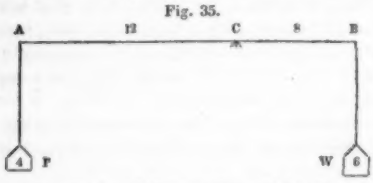
The third class is the inclined plane: this is susceptible of several varieties; such as the wedge, &c. as also the screw.

(It is to be observed, that all the principles of this science are grounded on false suppositions, but which are obliged to be admitted at present, in order to simplify the study. In the first place, there are several things, the effects of which are not taken into consideration; but which are never absent, as it is always (as yet) to be supposed that bodies move *without* friction, and that their surfaces are *perfectly* smooth. Again, solid bodies are supposed to be *perfectly* inflexible; also, that the cordage is *perfectly* flexible; that the machines are quite devoid of inertia; and, lastly, that they are free from the resistance of the atmosphere, all of which are false assumptions.)

With regard to the first class of machines; the rule for determining the effect or efficacy of a force to turn a solid body round a fixed axis, is to multiply the force by its distance from that axis.

A simple lever is the most common form of this class of mechanical powers, and is an inflexible bar, resting on a fixed point called the fulcrum, prop, or axis. The weight is whatever force the machine is applied to overcome, whether it be the turning a mill or any other thing. The power is the force applied to overcome the weight, whatever it may be. Let AB be the lever

Fig. 35.



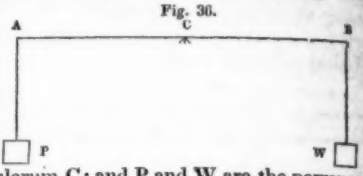
resting on the fulcrum C; and let P represent the power, and W the weight. Now the same principles that were before given will also apply here: for let P be equal to 4 lbs. acting at a distance (CA) of 12 from the fulcrum (the technical term for which distance is called its leverage,) and let W be equal to 6 lbs. acting at a leverage (CB) of 8. The mechanical effect of the power is $4\times12=48$, but that of the weight is the same $6\times8=48$; therefore the power and weight are in equilibrium.

Thus it is evident that any weight, however great, may be balanced by any power, if ever so small, provided there be sufficient length of lever.

There are three different kinds of levers; the difference of which consists in having either of their three parts (viz. the fulcrum, the power, and the weight,) in the middle.

In a lever of the *first* kind, the *fulcrum* is in the middle, and the weight and the power are on opposite sides of it. This is the most common form, and is represented at fig. 36, where AB is the lever, resting on the

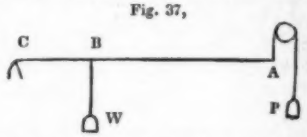
Fig. 36.



fulcrum C; and P and W are the power and weight, acting on opposite sides. There are many familiar instances of this kind of lever; as a crowbar, a poker, also the handle of a pump. In this kind the prop has to support a weight equal to the sum of the power and weight.

When the *weight* is in the middle it is a lever of the *second* kind, as shown in

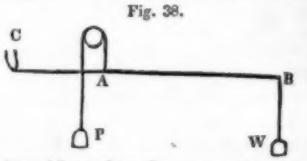
Fig. 37,



where the letters refer to the same parts as in the last. An oar is a lever of this kind; the water being the prop, the boat the weight, and the effort exerted by the rower, the power: a rudder is of this kind, as also a wheelbarrow.

In levers of the *third* kind the *power* is in the middle. This is the most unusual kind,

Fig. 38.

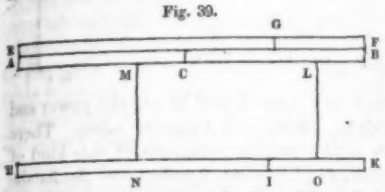


for it is evident that the power acts to considerable mechanical disadvantage. It may be asked why it is ever used. It is never employed for merely supporting a weight, but only when velocity is required: for as much advantage is gained in velocity as is lost in power, or, as is the technical expression, what is lost in power is gained in velocity. The bones of animals are instances of this kind of lever: for example, in the part of the arm between the elbow and the hand, the elbow may be considered the fulcrum, and the hand, or what is carried in it, the weight; and the place (about an inch from the elbow) where the muscle acts on

the arm, is the place on which the power acts. Now great velocity is gained by this arrangement; for, in a common-sized man, while the power moves one inch, the weight will move twenty inches.

There is a method for proving the principles of the common lever, introduced, according to some, as early as the time of Archimedes, but certainly not later than that of Galileo: it is thus—

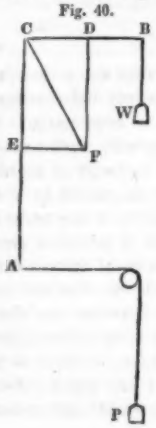
Fig. 39.



Let AB represent a perfectly uniform bar, suspended by its centre C. Upon this lay another bar, EF, of exactly the same length; it will still be in equilibrium. Again, if this bar be divided into two parts at any one point, viz. G, it will still be at rest. Now the centres of gravity of those two parts will be at their centres of magnitude, as they are perfectly uniform; consequently, if these two parts are suspended from the points on which these centres were pressing, (viz. M and L) by strings fastened to the centres of gravity N and O of the two parts HI and IK, they will still be at rest; and it is evident that the bar HI is to the distance IO, as the weight IK is to the distance IN, and which are exactly the same proportions as were before given.

It is not requisite that the lever be straight; the same principles will apply with regard to those that are bent. Let ACB (fig 40,) be a lever, whose fulcrum is at C, and let the weight W=20lbs. be suspended from a

Fig. 40.



point B, at a distance of 4 inches from C; consequently the weight has a tendency to produce motion equal to (20×4=)80. Now let the power equal to 5lbs. act on a point A, at a leverage AC=16 inches, therefore its tendency is 5×16=80, which is the same with that of the weight, consequently they are in equilibrium. The pressure on the fulcrum is not the same with either of the former kinds of lever; it is found in the following manner: on the line CB (fig. 41) take a part CD, in the same proportion to the opposite force P, as a part CE of the line CA bears to the weight W; and by completing the parallelogram CDFE, the diagonal CF will bear the same proportion as the pressure exerted on the fulcrum. A hammer when drawing a nail is an instance of this kind of lever.

The same principles also apply, whatever number of forces are applied. If the several forces, having a tendency to turn the lever round in one direction, be multiplied into their distances from the centre, and their amount be equal to that of the forces acting in the opposite direction, multiplied into their distances, and if they are equal the lever will be in equilibrium. To calculate the pressure exerted on the fulcrum, add all the forces downwards and from this sum subtract the sum of those acting upwards and the difference will be the pressure.

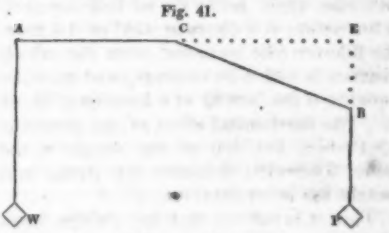
When the weight of the lever itself is to be taken into account, the rule is to find the centre of gravity of the beam; and from this point imagine a weight to be suspended equal to its weight, when the effect may be easily found by the last rule.

In practice, it is generally usual for the weight of the lever to be made to favor the power.

The next varieties of the lever are these—

First, when to a lever the forces are applied obliquely to their arms, let AB be

Fig. 41.



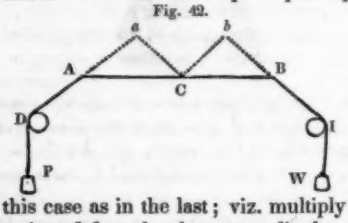
the lever, the fulcrum of which is at C, and let the power P, act on the oblique arm CB, and the weight W act at right angles to the lever, as AW. Now the tendency of a body to turn a lever round a fixed point, is found

by multiplying the force or weight into the length of a line drawn perpendicular to the direction of the force from the centre; but CB is not perpendicular to BP, consequently the line PB must be continued to E, from which point the perpendicular EC must be drawn; and the tendency of P to produce rotation, will be found by multiplying the weight P by the line CE, and not by CB. This rule is applicable in every case; and is this, that the *perpendicular* distance of the centre from the line of direction, multiplied by the weight, will give the tendency of that weight to produce rotation.

But even in this case the power and weight are still acting parallel to each other: the next case for consideration is, when they are not so.

Let AB be the lever acting on the fulcrum C, and let the power P, and the weight W act in the oblique directions AD and BI, by means of strings passing over the pulleys D and I. Now the same principles apply

Fig. 42.

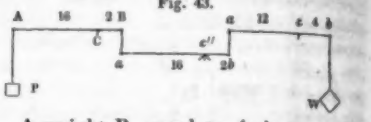


in this case as in the last; viz. multiply the quantity of force by the perpendicular distance of the line of direction from the centre. But CB is not perpendicular to BI (the line of direction,) therefore that line must be continued to a point *b*, from which point a perpendicular line will meet the fulcrum *c*, therefore the weight W must be multiplied by the line C*b*, which will give its tendency to produce rotation in the same manner: the effect produced by the power P is found by multiplying it, not by the arm of the lever CA, but by the perpendicular distance C*a*; and if these two effects be equal, the lever will be in equilibrium.

When there is only one axis it is a simple machine, however many resistances or powers there may be, or in whatever directions they may act; but when there is more than one fixed axis, the machine becomes compound.

The compound lever is the most simple of all the compound machines. Fig. 43 is an instance of this machine, where equilibrium is produced in three levers, by 4 lbs. placed at one extremity, A, and 768 lbs. at the end of the third lever, viz. *b*. There are in this figure three levers: the first AB, resting on the fulcrum C; the second, *ab*, resting on *c''*; and the third, *ab*, on the prop

Fig. 43.



c. A weight P, equal to 4, is suspended from the point A, at a distance from C of 16 inches; consequently, the force exerted in an upward direction at B, distant from C two inches, is equal to 32: this force is communicated to the lever *ab*, by means of a string fastened from B to a point *a*, 16 inches from *c''*; therefore a downward force is produced at the point *b* (two inches from *c''*) of 256: which force is again transmitted in the same manner as before, to a point *c* (of the lever *ab*,) 12 inches from the fulcrum C, and which will therefore keep in equilibrium a weight W, equal to 768, acting at a point *b*, at a distance of 4 inches from *c*.

There is another way of expressing this. Take the length of the three arms presented *towards* the *weight* which multiply into each other: do the same with those *towards* the *power*, and the two sums will be in inverse proportion to the weight and power. This may be mathematically expressed thus: $\overline{BC \times bc \times bc} : \overline{AC \times ac \times ac} :: P : W$: which is $\overline{2 \times 2 \times 4} : \overline{16 \times 16 \times 12} :: 4 : 768$, or $16 : 3072 :: 4 : 768$.

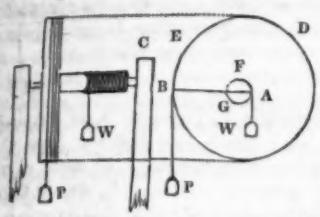
It is not necessary that they be all levers of the first kind: the same principles will apply whether they are of the second or the third, even or crooked, &c.

There are many defects attending the lever as a practical machine. First, where the power moves through a considerable space, the weight, on account of the different lengths of the arms of the lever, is moved through a very small space. Again, it is an intermitting machine; that is, the effect is not continual: for, in the instance of raising a block of stone, the weight is raised until the end of the lever at which the power acts has reached the ground, when the weight must be supported until the fulcrum is raised, and so on. To modify this intermission, and to continue the motion, the wheel was made use of; and when it is used, it is called the wheel and axle: in which form it has been by some called a separate mechanical power.

Fig. 44 is a side view, and fig. 45 a section of this machine; and it will be only requisite to prove its principles to be the same with those of the lever for its power to be known. (The same letters refer to each fig-

ure.) Let EDB be the wheel, and AFG

Fig. 44. Fig. 45.

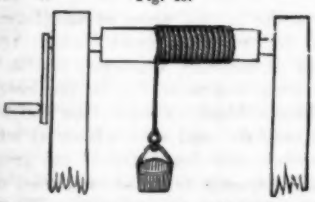


the axle, having the common centre C. Now, by drawing the line AB in fig. 45 it is plain that it can be reduced to the lever AB resting on the fulcrum C; the power P acting on the end B, and the weight W on the end A: consequently to find the effect of the power P to produce rotation, it must be multiplied by the radius of the wheel on which it acts. The tendency of the weight W is also found by multiplying it by the radius of the axle; and if these are equal, equilibrium must ensue.

The wheel and axle is liable to the same observation as the lever, that though a large weight may be kept in equilibrium by a small power, yet the power does not support the weight; it is the fulcrum or pivots which support them both.

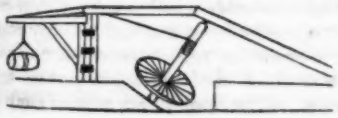
The efficacy of a force to produce rotation round an axis is found (as before stated) by multiplying it into its leverage, and the resistance is found in the same manner; and the whole efficacy of a machine is found by the surplus of the effect of the power over that of the weight, and it may be increased by either decreasing the leverage of the weight or increasing that of the power.

Fig. 46.



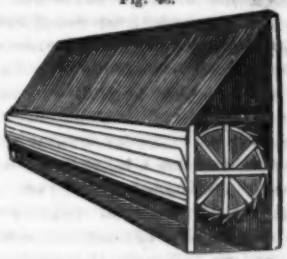
There are several ways of applying power to the wheel and axle; by a winch, as in that used for raising water from a well, (fig. 46.) by the weight of animals, as in the crane represented at

Fig. 47;



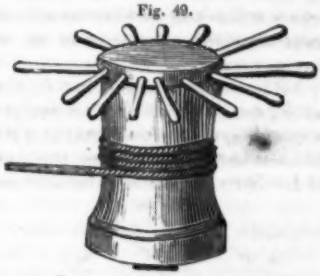
by the weight of men, as in the treadmill,

Fig. 48.



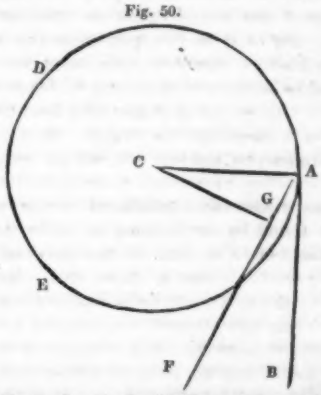
The capstan is an instance of this machine; only here the axle is perpendicular.

Fig. 49.



It will be evident that the power should always, when it can be accomplished, act tangentially to the wheel, for the force of the power is always estimated by its perpendicular distance from the centre. Let the line AB, fig. 50, represent a force acting tan-

Fig. 50.



gentially to the circle ADE, and let AF be another force acting obliquely. Now, the effect of the force AB will be $\overline{AB \times CA}$, (for CA is perpendicular to AB,) and that of AF will be $\overline{AF \times GC}$, (for GC is perpendicular to AF,) but GC is evidently less than CA; therefore the force AB acting tangentially is greater in effect than AF acting obliquely. In the same manner it may be

proved that the power always has the greatest effect when it acts tangentially to the centre.

When the wheel is worked by a winch, it is generally attended with disadvantage: thus, if a man be the moving power, he is alternately stretching forward and pulling up; and the former being the much more effective position, the motion is very irregular. This is sometimes obviated by using two winches, one being at each end of the axle; or by two men working at the same winch; for when one man's power is at its maximum, the other is at its minimum, and the sum of these two effects at any position will be the same.

(To be continued.)

COMMUNICATION.] [FOR THE MAGAZINE.

WATER AND THE SYPHON.

Mr. Editor,—Since the introduction of manufactures into this country, the value of water-power, has greatly increased. It is of course used with more economy, and to better purpose than formerly; this may be seen by comparing the ancient water-wheels, with those now in use. Nothing leads so directly to national wealth, as industry and economy. The economy of water, like every economy, is wealth in reserve, since it is the means, and the motive of industry, which produce wealth. Water should be economized also for other purposes, than mechanical power; it is an important agent in agriculture, and in old countries, where it is necessary to draw from the earth all it can yield, water is scrupulously economized for irrigation. In this new country we have not yet had occasion to require of this great and powerful menstruum of nature all that it is capable of yielding. It may be well however for those who have water at their command, to study all its capabilities, and modes of application. A small patch of land may be made more productive, than a much larger tract, where water is at hand. Water is not only an analizing but a synthetical agent, it joins together as well as separates; the animal, the vegetable, and the mineral kingdom, live by its influence, and know its power. Considering then, what an important part water has in all the works of nature, to do or to undo, we cannot prize it too much for the arts, or assign it too high a place in our consideration, as an object of science.

If I place before the publick, through your valuable Journal, some speculations on water, which I have already made publick through the newspapers some years ago, I shall accomplish first, the desire I have to accede to your wishes, by contributing something towards the young and interesting enterprize which you have in hand; and it is possible that these hints, which are not new to many of your readers, may fall into the hands of others who may use them, and improve upon them, for their own profit, and for the advancement of the common interests of society.

We hear sometimes of a great drought, and no water to be had for the cattle, without travelling several miles. This should never happen in any country where it rains. I have lived in a city where there are six months of the year without rain, yet there was no deficiency of water, although they had no aqueduct. Having mentioned this to a gentleman who has a large and valuable farm at Milton, near Boston, he informed me that he could get no soft water, and that the water in his well was often very low. I proposed a means of supply, which he adopted, and he has had an abundance ever since. It was simply this: A part of his land was above the level of his house, but the house standing on a little elevation, the water which I proposed to collect from the surface of the elevated grounds, and which ran to waste, could not be brought directly into the house, but there was a low place a few rods from the house where the water from many acres would naturally find its way, from the shape of the ground. In this place I advised him to dig a reservoir, ten or twelve feet diameter, and as many deep, and to conduct the water from this place to his house, by a leaden tube, to be drawn up by a pump, the difference of level being about twelve feet. Thus he has had ever since a constant supply of soft water, and much to spare.

Now I can hardly imagine a farm that has not some one place, lower than another, from which water may be conducted to a reservoir that would supply all the wants of the owner at a very small expense. If it be inconvenient to have the reservoir near the house, a place may be selected at any distance. If it be higher, it may be brought home, by its own gravity, and become an aqueduct, with an artificial source; if there be an intervening hill, not above 32 feet, the leaden tube, acting in this place as a syphon, will draw the water over, and it will then continue to run by its own weight. If the place of the reservoir be altogether lower, but not more than 32 feet lower than

the house, then the water may be drawn as in the case at Milton.

The principle of the syphon, was known to the ancients, notwithstanding they did not use it in bringing water to their cities. It would have been too costly to make tubes of sufficient dimensions, for the immense quantity of water then required for bathing, and works of luxury, as well as for other purposes: hence their gigantick aqueducts, over the vallies.

The syphon may be used however, with considerable effect, in conducting water even to great distances. For example, suppose that it were desirable to use the water of a pond, or a river, in some place where it could be brought with ease, by its own weight, except in one spot of the route, and that a hill of rock: it might be too expensive to cut this hill down, thirty or forty feet, to give passage to the water; but it might be worth the expense of cutting ten feet, so as to reduce the elevation to 30 feet, over which the syphon would draw it, and it would then continue to run naturally to its issue.

Water may also be carried far, by a series of syphons, over a plain, where it might not be expedient to dig a trench so low as the water in a well, a river or a pond, from which you might wish to conduct it. To this effect, you would first dig a reservoir, at some convenient place, and distance from the source, and a little deeper than the lowest known level of the water at the source: now a syphon more than a mile long, and of very large dimensions, will take the water constantly from the source to the reservoir, and keep it at the same level in each place. Thus by repeating this operation, water might be carried from the Nile, over the deserts to the Red Sea, if there were no elevation in the way too high to be overcome. There would be then a series of wells, the whole distance, with the water of the Nile in them no lower than the surface of that river.

The same process might be employed to bring an inexhaustible quantity of water from Fresh Pond to this city, provided we could be satisfied to have the water in the reservoirs, on a level with the water in that Pond. We have many reservoirs ready to our hands, and it would only be necessary to multiply them, or to allow individuals to construct others on their lands, and connected with them, or to have pipes leading to them. The same might be done with some good, but too copious wells, which we have in this city; from which twenty more wells might be supplied, each tending to improve the water of the first.

Marshes, and ponds, may be drained by syphons, where it would be too expensive to do it by deep cuts, wherever a place of issue a little lower than the marsh, or pond, can be found, within a practicable distance. In this case, the water may be carried in an open drain, or in a French drain, as far as the level will permit; and then taken from that point, to the place of issue. Should the marsh or pond, have no lower place than ground covered by tide waters, still such locations will afford an intermittent draining, which will continue all the time that the tide is lower than the pond or marsh.

The syphon may be used, and save much labor, in taking water, or other liquids, from one vat to another. Sea water may be thus carried in level countries, far back from the coast, by stations, for the making of salt, or to enrich the land.

Several years ago, on the suggestion of the writer, water was taken from one well to another, in Charlestown, and carried to a distillery several hundred feet distant, by a tube less than one inch diameter, which yielded about fifty hogsheads daily.

If water should ever be taken from Fresh Pond, for the use of this city, the whole quantity required, may be raised into a reservoir near the pond, by wind, or steam power; or it may be brought as first suggested, into the city, and such parts of the city, as would be found too high, to draw it with convenience, to those places (which would be but two or three,) could be supplied at a small additional expense, by a power to fill one or more reservoirs, on the summits, of those parts of the city.

In mining for stone, coal, or other substances, much labor may be saved in extracting the water, wherever there is a place in the vicinity, lower than the water to be drawn off, and not separated from it by an elevation greater than 32 feet, or which may be reduced to that point, by a cut, or a horizontal bore. If it be necessary to raise the water, from a greater depth, by power, still there would be an economy of the power requisite to raise it the remaining 32 feet.

The feeders to canals, or mill streams, are commonly taken, and conducted, in the natural course of the water; but as contrary streams are often separated by ridges within the limits of exhaustion above, viz. 32 feet, it will be seen that the contrary streams

may be made to take the same course, and thus an additional quantity of water brought into a feeder of great length, and which may have cost much money, with the small additional expense of a few roods of pipe, and a little excavation. AQUARIUS.

COMMUNICATION.] [FOR THE MAGAZINE.

VENTILATION OF HOSPITALS, PRISONS AND SHIPS.

MR. EDITOR.—However useful and desirable may be a periodical like the Mechanicks Magazine, it will be found, I apprehend a work of much difficulty, if the Editor calculates on much, or regular aid, from voluntary contributions. We are all more ready to receive information than to impart it. An invitation to a festival is rarely refused; but few are disposed to cater for the gratification of others. In this business community, the first, and almost the only object, is to make a living, or to accumulate wealth. Writing is not a business with us, or to say the least, it is not a profitable one, or such as will command the best talents. Such qualifications as would be required for the task, can be turned to a better account. You must expect then, even from such contributors as feel the importance of your work, and wish it all possible success, only those ephemeral essays, which can be thrown from the memory, at some moments of leisure. They have neither the time, the materials, nor the qualification, to produce, to file down, and to elaborate, articles, such as would be expected from professed, and paid writers. I would recommend to the *charitable* European criticks, to give the remarks above a little consideration. There are many things, which we must yet look for, in distant, and older countries, notwithstanding that *new policy*, which would carry us by forced marches, of mind, as well as of matter, into unknown regions, without chart or compass, or enough of the proper implements for a successful settlement. This quick-time march is not that of nature, which is always slow, and progressive, in the production of her most perfect works. We cannot jump into a state of society which has been the product of ages. We cannot by forcing-fires, raise exoticks for our daily, and common food. We cannot new mould in a day, even this young society, (but two hundred years old,) for purposes, which belong to a state of society, which has been made what it is, by ages of error, and truth; virtue, and vice; and is in all respects so different from our own. We can hardly draw a figure, or quote a proverb, or recite a fable, that will strictly apply to our own circumstances. We must then of necessity be content to draw many things from Europe, even of science, and literature. But in this promiscuous importation, it may be hoped that heavy duties of reprobation may be laid voluntarily, and by publick acclamation, on all sorts of notions, moral, political, religious, legal or physical, which are at variance with our own institutions, or which may have a tendency to assimilate our condition, to that of countries, whose lot does not appear enviable, to those of us who have made the comparison of the two.

I have now proved to you, by this page of inappropriate matter, what I insinuated in the beginning, viz. that it is easier to draw two pages from the head, than one from the alcove, especially from an alcove without documents.

I must return to my subject, or this piece will be called a piece of wind, rather than a piece on ventilation.

In my travels I have never seen a hospital, a jail, or other publick building, where suffering humanity is congregated, properly ventilated; yet good air is considered by medical practitioners, as one of the curative specificks. I have suffered much by seasickness, and as much by the continued nausea occasioned by the bad air of the ship, after that occasioned by the motion had passed away.

After visiting hospitals, and prisons, which I have had occasion to do in Europe, being somewhat of a speculative, mechanical cast, I have turned my thoughts to the remedy for the evil above mentioned.

The lectures on chymistry, so fashionable many years ago in Paris, led to many disinfecting processes, which were all more or less efficacious. After attending these lectures I would frequently try my little experiments like others. I almost poisoned my family, one day, by having the soup made of some of my disinfected meat. If my wife, who has not forgotten my culinary chymistry, were to see this, she would burn it for fear that I might kill the inmates of our hospitals.

I learned at the lectures above mentioned, that heavy gases, like the carbonick, are those which are most immediately noxious. From this simple fact, it occurred to me, that the usual modes of ventilation, were imperfect, in as much as that those gases, are often confined in the lower parts of the room, without the necessary and constant means

of escape. The remedy for this defect is simple and will occur to any one: yet simple as it is, it seems not to have attracted attention.

I would recommend first, to locate publick buildings so that the prevalent winds should sweep through their greatest length; and if that cannot be conveniently done, let the buildings be so placed that a ventilation may be aided, by as much difference of temperature as possible, from one side to the other. Next, let the windows at each end of the corridor, or main passage way, be large, and even with the floor, and openings from all the cells into this corridor, in the bottoms of the doors. Let a fan-screen, embracing the whole width and height of the corridor, be swept rapidly through, from end to end, while one of the windows is open, and the other shut, the heavy gases will thus be driven forward, out of the window, and the vacuum produced in the rear, will draw all the bad air from the cells, and be driven out at the other window, on the return of the fan-screen. The windows of the cells should be opened during this operation, that fresh air may take the place of the bad, and thus disinfect the walls, and furniture, by a repetition. The chymical process kills the animalcula, which are one cause of bad air, but the dead carcases of these myriads remain to assume some new, and perhaps, offensive form; while the other simple process, takes them all away. The corporeal emanations, are I believe, principly of gas azote; (I am not a physician,) but much of those, which proceed from digestion, must be, I should think, carbonick, of course very heavy, and cannot escape through high windows, or through those apertures we sometimes see in the walls for the purpose of ventilation.

In relation to ships, it will be readily seen that there is no natural escape for any gases which are heavier than the atmospherick air: they must of course be pumped out. That much of this gas is carbonick, will appear probable, when we consider, that in addition to those which proceed from the digestive powers of the crew, may be added that constant digestive process, or slow combustion, which is at work among all the materials in the hold, and the ship itself, alternately wet and dry, and the cargo, too, which is commonly of vegetable origin. It is wonderful that this great laboratory of gas, should not do more mischief than it does.

About ten years ago, being the owner of a rum distillery, and observing the process of ventilating the vats, when the fermented liquor was drawn off, which was done by swinging a bag over the opening, it occurred to me, that the thing might be done more expeditiously, and effectually, by pumping. For this purpose I had a square pump made, by uniting hermetically four boards plained smooth within, and about eight inches in the clear. At the bottom of this pump, I fixed a stationary box, with a valve of paste board very light, but made air-tight by lining the edges with soft flannel. The moving box was furnished with a similar valve, and in place of the leather used in common pump boxes, I surrounded this with a piece of soft, but close fur, sufficiently compact to prevent the escape of the air. The box, and spear, and the element to be removed, were all so light, and the friction so trifling, that I could work this pump, of eight inches bore, with my thumb and finger, and exhaust the gas from a vat of 25 hogsheads in two minutes.

This little experiment induced me to write, and publish, a newspaper essay on the means of freeing ships from foul air. The substance of which was as follows: Place a pump like the one described above, of metal, or wood, round or square, in the well-room, with the other pumps, of such dimensions as the size of the ship may require—it may be a foot square, or more, as the labor of pumping is very small. It will not be necessary to have conductors beside the keelson, through the ship, unless the vessel be intended for coal, salt or grain; then it will be necessary to have some means of circulation, fore and aft, either in the dunage, or otherwise. To admit the fresh air, while the bad air is pumping out, if the openings of the forecastle, and the run, or place under the cabin floor, be not sufficient, it would be easy to have a few plug-holes in various parts of the ship, to be opened during the operation. If the cabin floor be so tight as to prevent the heavy air from descending into the hold, from the cabin, it will be necessary to have some opening for that purpose, with a valve, closing upwards, if it were apprehended that any light, and offensive gases, would come from the hold. There are but few landsmen, who do not dread the bad air of the cabin. The difficulty of breathing, the parched lips, and nausea experienced, especially in the morning, after a long night, have been experienced by all those who have made voyages by sea. That these are heavy gases which produce this effect, would

seem probable, otherwise they would rise through the companion way, which is open all night. During the day, there is less of it evolved, as the officers, and passengers, are commonly on deck; and the moving about is a continual power, which divides, and drives it out.

There are few passengers, who would not give the preference, to a ship, with such an apparatus as would furnish them with a constant supply of fresh air. Moreover the preservation of the ship, and cargo, would be promoted by a free circulation of pure air. Many vessels have been ruined in one voyage, by a fermenting hot cargo, and whole crews taken off by sickness, which might have been avoided by an effectual, and constant ventilation, and cargoes of grain are sometimes spoiled for want of air.

Other means may be employed for the same effect, but none more simple than a pump, which may be made to serve, on an emergency, to free the ship from water, by having a set of boxes in reserve for that purpose, and which may be worked by a pulley, as bailing buckets. Such pumps may be easily, and cheaply made, by uniting four planks with screws, and to keep them tight, and secure from the action of the air, they may be coated with tared sheathing paper, and then covered with rough boards. For ships of war, a revolving exhauster might be made, to be worked on deck, communicating with the hold by a tube: on a large scale it might prove more expeditious in exhausting the bad air.

During the two last sessions of the Legislature of Massachusetts, we have experienced much inconvenience, in consequence of the bad air produced by a very numerous assembly. We have for that hall, ventilators, however, over the cornice, and many windows. But it is evident that these openings do not let off the gases, produced by many gallons of cider, wine, and vegetable food, constantly evolving from five hundred gastrick laboratories. The shape of this hall is the best possible to retain these gases; the pit, or centre floor, being about four feet below the thresholds of the doors! I proposed to a member who sat next to me last winter, to make a motion, for ventilators in the floor, but it was near the close of the session, and the project was passed over. It was my intention to take a phial of the air, from the lowest stratum, after a long sitting, and compare it by weight, with the atmospherick air, but this experiment, was also postponed. ÆOLUS.

WORKING IN LEAD.

The importance of preventive means against the poisonous influence of lead, will be evident, when we reflect on the great number of workmen, in different trades, who handle this metal, or are exposed to the dust or vapors from it, in manufactories. A late work, of high character, enables us to point out, in a satisfactory manner, the requisite steps to be pursued for guarding against the deleterious effects of this metal, by painters, potters, glaziers, printers, and founders, who handle lead, either alone or in combination; and by manufacturers of white and red lead, and miners, who are exposed to the additional danger of its vapors.

By all, the utmost regard to cleanliness must be paid—a point too often neglected. In proof of its importance, Merat observes, that he knew a potter who contracted the lead colick in early life, when he was accustomed to go about very dirty; but for thirty years after, he had not any return of it, in consequence, simply, of a scrupulous attention to cleanliness. To secure its observance, the hands and face should be washed different times in the day, the mouth frequently rinsed, and the hair combed morning and evening. Frequent bathing of the whole body in water, of a temperature which shall depend on the season, is of great consequence with a view to cleanliness; and provision should be made for baths, by the heads or proprietors of establishments in which lead is employed. The workmen should never take their meals in the workshop; and before eating they should wash their hands and lips with soap and water, and brush out all particles of dirt which may have lodged under the nails. It is also of some moment that they breakfast before going to work in the morning.

Derangements of the digestive organs should be watched with great care. If they appear to arise from the poison of lead, the individual should leave off working with the very first sympton, and should take some medicine, such as castor oil.

The nature of the diet of the workmen is of some moment. It should be, as far as possible, of a nutritive and digestible kind. Merat condemns, in strong terms, the small, tart wines generally used by the lower ranks of his countrymen. They constitute a very poor drink for all artizans; and are peculiarly ill adapted to those who work with lead, because, besides being at times themselves adulterated with that poison, they are apt

also to disorder digestion by their acidity. The same remark applies to cider. Beer is to be preferred. It is, we believe, a fact familiar to those concerned in lead manufactories, that the drunkards are those among the workmen who are most apt to suffer from the poisonous effect of the metal.

There is some reason to believe that the free use of fat, and fatty articles of food, is a preservative. De Haen was told by the proprietor of a lead mine in Styria, that the work-people were once very liable to colick and palsy; but that by changing their diet, and eating a good deal of fat, especially at breakfast, they were exempt from these diseases for three years. At Osterhout, near Breda, there had not been witnessed a single case of lead colick in the course of fifteen years, among a great number of potters; this immunity was attributed to their having lived much on cheese, butter, bacon, and other fatty kinds of food. It is further stated, that at the lead hills in Lanarkshire, the English workmen who live much on fat meat, suffer less than Scotchmen who do not consume it.

The working clothes should be made, not of woollen, but of strong compact linen, and should be changed and washed at least once, and still better, twice a week, and should be worn as little as possible out of the workshop. While at work, a cap of some light impervious material should always be worn.

The workshop should be spacious, and both thoroughly and systematically ventilated; the external air being freely admitted when the weather will allow, and particular currents being established, by which floating particles are carried through the workshop, in certain invariable and known courses. Miners, and others who work at furnaces in which lead is smelted, fused, or oxidated, should be protected by a strong draught through the furnaces. Wherever furnaces of such a construction have been built, the colick has disappeared, while it continues to recur where furnaces are still used of the old, low-chimneyed form. Manufacturers of litharge, and red lead, used formerly to suffer much in consequence of the furnaces being so constructed as to compel them to inhale the fine dust of the oxides (or calcined metal.) In drawing the furnaces, the hot material is raked out upon the floor, which is two or three feet below the aperture in the furnace, and the finer particles are therefore driven up and diffused through the apartment. But this obvious danger is now completely averted by a subsidiary chimney, which rises in front of the drawing aperture, and through which there is a strong current of air attracted from the apartment—the hot material on the ground performing the part of a fire.

In white lead manufactories, a very important and simple improvement has been effected of late in some places, by abandoning the practice of dry-grinding. In an extensive white lead manufactory at Portobello, near Edinburgh, the whole process, both in preparatory rolling, and ultimate pulverizing, is performed under water, or with damping; and to this precaution, is, in a great measure, imputed the improvement which has taken place in the health of the workmen, and their superior immunity from disease, over those of Hull, and other places where the same precaution is not taken. The only operation now considered dangerous at the Portobello works, is the employing of the drying stove, and the packing of the white lead in barrels; and the dust is then kept down as much as possible by the floor being maintained constantly damp.

By these precautions, and by care being taken to make the workmen wash their hands and faces before leaving the works for their meals, and to administer a brisk dose of castor-oil on the first appearance of any complaint of the stomach or bowels, the manufacturer succeeded in extirpating the *colica pictonum* (lead colick) entirely for several years. Last year it appeared again to a limited extent among the work people, apparently in consequence of the rules, as to cleanlines, not having been so carefully enforced.—(Journal of Health.)

COMMUNICATION.] [FOR THE MAGAZINE.

SAFE SHIPS AND STEAMERS.

There is so much deep and speculative science now in circulation, all over the world, that it may be a source of relief, to the readers of scientifick Magazines, to find occasionally, a plain and simple proposition of something merely useful, to the human race; something after the fashion of Franklin, *a la Franklin* as the French philosophers used to say, when any thing appeared, which had no other recommendation, than its own intrinsick merit.

The following invention is not new, the Chinese have practised it, from time immemorial, in the construction of their largest vessels, or junks as they are called. These

junks are divided by several water-tight divisions, or bulk heads from the bottom to the deck; so that in case of leakage in one division not only the goods in the other compartments are safe, but the buoyancy of their divisions prevents the vessel from sinking, and gives time, either to make a port, or to throw over a part of the cargo, and thus save the ship and crew.

Here we may borrow something useful, from a semi-barbarous nation; and why not, since we have so often taken from the brute creation, hints, which form the basis of some of our boasted sciences?

If our steam-boats were divided in the construction, like the Chinese junks, it can hardly be doubted, that they would be much safer. These boats are so heavy laden, with the machinery, and passengers, that in case of a great, and sudden leak, the risk of a total loss, would be very great; the boats could not be depended upon, in an open and rough sea, nor would they accommodate the number of passengers which are frequently embarked. Some little inconvenience might be experienced in passing from one division to the other, but I believe that there are but few travellers who would not consent to go up one pair of steps, and down another, for the sake of being more secure, from hot steam, or cold water. I should suppose that these bulkheads, by being made very strong, and convex towards the boilers, would resist any explosion. For my own part, although not more timid than my neighbors, I would pay double fare willingly in a boat so constructed, especially, if I had my family with me. And I think it not unreasonable to suppose that a boat so fixed, would command the great majority of the passengers.

I see no valid objection to the same improvement in freighting ships, and packets. The Chinese have found their account in this practice, or they would not continue it. It may be said that these divisions would injure the stowage of goods. This would be true, in some small degree, and with certain goods, more than others. With coals, salt, iron, grain, bale goods, boxes, hemp and many other articles, the loss of stowage would be very small. But the main question is this; would not the risk of loss, and damage, more than compensate this trifling inconvenience? The trial may be made, at no great expense, and fairly tested at the insurance office. As a stock-holder in more than one insurance office, I am ready to say in advance, that I should be willing to make a deduction on the risk of the cargoes that a ship so constructed, would carry, during her time of service, that would pay ten times over, the extra cost.

What are the sea risks? first, that proceeding from the negligence of construction, next the running foul of other ships, or on islands of ice, cannon balls, and, finally, the rocks and sands. The defects of construction, such as a butt imperfectly secured, or the neglect of auger holes, may not reasonably be expected in every part of a ship, and in the case of striking against another ship, ice, rocks, or sand, it is well known that the damage is principally confined to the part which first receives the blow; but a wound is then made, which soon fills the ship with water, and she sinks. But if a fourth or a fifth of the capacity of the ship, only, were exposed to the leak, it is evident that she would not sink from that cause. A ship frequently strikes the rocks, or a sand bar, but once, and may be got off, if the crew are at liberty to work to that effect, and are not in too much danger of their lives, to think of anything else. A ship may strike a rock, the ice, or another ship, and pass on, if the leak be not too great to keep her afloat, which it evidently would not be, if but a small part of the hull were injured.

Passengers, it is believed, would also prefer a ship with this additional means of safety, and be willing to pay something extra for their passage. NEREUS.

Our correspondent's views are very similar to those of Dr. Franklin, in his *Maritime Observations*, (which will be found at p. 68;) the Dr. thought that whatever loss might be sustained in the stowage, would be more than compensated by an abatement in the insurance.

Mr. Watson's plan for preventing ships foundering at sea, is much more feasible, we think, than any other that has come under our observation. The reader will be reminded of it by recurring to p. 123.—ED.]

CRANE'S IMPROVED TOWN CLOCK.

Messrs. Curtis & Dunning,

"In compliance with your request that I would express to you my opinion of the Turret Clock which I had an opportunity of examining at your manufactory a few days since, and which you informed me was invented by Mr. Aaron D. Crane, of Caldwell, New-Jersey, I remark in the first place that the examination of it gave me a

very high opinion of the genius of the inventor. I have not within a long time examined a piece of machinery that appeared to show a higher degree of originality, simplicity and beauty in its construction.—Though I have had too little *practical* acquaintance with the different kinds of clock machinery in use to authorize my speaking, except with much diffidence, of its fitness to answer the purposes for which it is intended, yet I will briefly enumerate some of the particulars in which it seems to me to differ from others, and in most of which I cannot but judge it much superior to them.

The first thing which must strike the eye of every one when first looking at it, is the peculiarity of its pendulum and principal escapement. I hardly know how to characterize its pendulum except by saying that its construction and movement seemed to approach nearer to those of a scale beam with its points of suspension farther than usual above its centre of gravity. The consequence of this arrangement is the apparently paradoxical one, that a pendulum very *short* vibrates very slowly. If there are no special ill effects produced from such a construction (and I do not see any) there certainly must be some obviously good ones. The principal escapement is a singularly ingenious and simple piece of mechanism, which must be seen to be understood. I say the principal one, for there is this usual arrangement in this clock, that almost every wheel has an escapement of some sort—each excellent and peculiar, but the one immediately connected with the pendulum, particularly so.

2d. It seems to me a very important improvement that the hands (which in the common publick clocks, from the action of the winds, cause the machinery to labor very much at times, and of course to go irregularly) are moved by a small and separate power which is allowed to act at small and definite intervals from the simple release of a detent by means of the principal moving power. By this means it seems to me the regular movement of the whole is nearly, if not entirely, independent of the action of the weather on the parts exposed to it.

3d. The adjustment of the striking part is decidedly superior to the methods commonly resorted to. With far less weight a more forcible blow is given, and while all flies or balance wheels are dispensed with, the whole movement is very regular. The great ease moreover with which the adjustment can be made for striking a bell at any requisite distance from the clock, is also very much in its favor.

4th. The fewness of its principal parts was surprizing to me; and the slight friction of the whole machine was strikingly conspicuous in the fact that the weight required to move it (it being calculated, as you state, to go a *year* with once winding) was not more than one fourth, or at farthest one third, of that required by common publick eight-day clocks—this too with the required fall of the weight not being more than twenty-five feet.

Experience may show difficulties in making it perform as intended, and for aught that I know, persons more skilful than myself might detect them even now, but according to my knowledge and judgment it seemed to me to be a great and valuable improvement, and I hope that you may soon have the opportunity of learning from actual trials that its operation will be all that you and its inventor can hope for.

Yours, G. W. Benedict.

Burlington, Vt."

Ferguson.—The last number of the Library of Entertaining Knowledge, published by Messrs. Wells & Lilly, gives a very interesting account of Ferguson, the astronomer, who, originally a tender of sheep, and of weak body, spent his nights like the Chaldeans, in studying the heavens.

When a little older, he went into the service of another farmer, and a respectable man, called James Glasham, whose name deserves to be remembered. After the labors of the day, young Ferguson used to go at night to the fields, with a blanket about him and a lighted candle, and there laying himself down on his back, pursued for long hours, his observations on the heavenly bodies. "I used to stretch," said he, "a thread with small beads on it, at arms length between my eyes and the stars; sliding the beads upon it, till they hid such and such stars from my eye, in order to take their apparent distances from one another; and then laying the thread down on a paper, I marked thereupon by the beads." "My master," he adds, "at first laughed at me; but when I explained my meaning to him, he encouraged me to go on; and that I might take fair copies in the day time of what I had done in the night, he often worked for me himself. I shall always have a respect for the memory of that man." Having been employed by his master to

carry a message to Mr. Gilchrist, the minister of Keith, he took with him the drawings he had been making and showed them to that gentleman. Mr. Gilchrist upon this, put a map into his hands, and having supplied him with compasses, ruler, pens, ink and paper, desired him to take it home with him, and bring back a copy of it. "For this pleasant employment," says he, "my master gave more time than I could reasonably expect; and often took the threshing flail out of my hands, and worked himself while I sat by him in the barn, busy with my compass, ruler and pen." This is a beautiful, we may well say, even a touching picture—the good man so generously appreciating the worth of knowledge and genius, that, although the master, he voluntarily exchanges situations with his servant, and insists upon doing the work that must be done, himself, in order that the latter may give his more precious talents to their more appropriate vocation. We know not that there is on record, an act of homage to science and learning more honorable to the author.

COMMUNICATION.] [FOR THE MAGAZINE.

A SAFE CHAISE.

A chaise is a very convenient carriage, easy for the horse, and quite a favorite in New England. It is not a safe carriage, however. To make it so, is the object of this communication; for which I will claim no patent right, although as worthy of it, perhaps, as some other novelties of the day. Your useful Journal shall have all the honor, and all the profit of the invention. I live on a frightfully, smooth and rapid, M'Adamized street, down which the flying dandies, delight to roll their gigs, to my great annoyance. My invention grew out of love for this interesting race of animals, or their horses, whichever you may please to believe.

In the place of the steps, let there be affixed, a semi-eleptical, and strong iron, like a stirrup, embracing more of the shafts than the common iron step; fasten one end farther forward, and the other farther aft, and reaching to within six or eight inches from the ground. A cross bar, or two, on this stirrup, will answer the purpose of steps. If the horse fall, the iron will touch the ground, and keep the chaise so upright, that no one can be thrown out, and the horse will fall clear of the shafts, and not break them.

I proposed this improvement to a chaise maker, who thought, that it might be more serviceable to those who ride, than to those who make and mend chaises.

FRANKLIN PARVUS.

We think our correspondents plan a very good one, and especially would it so be found on our smooth New England roads, where few, if any, obstructions are to be met with, at least of sufficient size to come in contact with the stirrup. It would be no disparagement in the appearance of the vehicle, and even if it were, its utility should silence such objections, and give it a decided preference over the present elegant, but very unsafe, chaise. Accidents, and some truly serious, frequently happen to persons when riding in chaises of the present construction. We will mention a couple of instances, which have come within our own observation.—The first, a lady and gentleman descending a hill at a moderate trot, (he *deserved* to be *served* so for his imprudence,) his horse stumbled and fell, the lady was thrown quite to the horses head, while the unlucky driver, owing to his stature, (about six feet,) was thrown with such violence against the front top of the chaise, as nearly to dislocate his neck. The second, a gentleman, his wife and child, were all violently ejected from their seats in pretty much the same manner as the first, and all badly hurt, the child had a piece of flesh cut entirely out of its leg. We mention these accidents (and numerous others might be mentioned) in hopes that a carriage, so much in use as the chaise, may be made more safe by applying the above plan, or, if possible, a better one.—ED.]

Watt's Machine for making Sculptures.—"Mr. Watt invented and made a machine for executing sculptures, which he never disclosed; he showed me many specimens of the performance in ivory and alabaster in 1814, and made me a present of one carved by his machine, which proved that it must have arrived at considerable perfection; he died in 1819, and, I believe, never disclosed that invention any farther than as the machine may have explained itself. He was striving to make it carve marble and hard materials, and he showed me some first trials in stone, but they were not perfect, and he did not live to complete a large machine adequate for executing real sculptures in marble."—(Mr. Farey's Evidence before the Committee on the Patent Laws.)

CHYMISTRY.

The article below, and more that will follow in future numbers of the Magazine, under the head of Chymistry, will be of interest to the reader of the present moment, and of use at a future time, as a sort of text book. They are extracted from a valuable English work.

OF THE METALS.

At the period when the existence of a number of brittle metallick matters was ascertained, and it was admitted that all their properties approach those of the ductile metals, these began to be distinguished by the terms, semi-metals, as if ductility were the most essential character of these bodies in nature, as it is in the uses of art. Man, therefore, referring every thing to himself, and his events, gave to these bodies a determinate rank and place from their utility to himself. Another idea, less reasonable, no doubt tended to confirm this expression of the semi-metals. The alchymists imagined that all the metals were only efforts of nature towards the production of gold, considered as the most perfect of metals, and that, by a subterraneous operation of nature, inimitable by art, they were capable of arriving at a state of maturity and perfection so as to become gold; and that all the metals were only successive states from a less to a greater degree of perfection, unto the the last state, namely aurification. Now, as ductility is one of the most prominent characters of gold, and the metals properly so called approach more or less to it by this character, those metals which did not possess it, appeared to them to be the first essays of nature, the embryos or metallick germs not yet developed. Hence the expression of semi-metals to designate such bodies as had not undergone more than a semi-metalization.

But the slightest reflection is sufficient to show, that the application of the same idea must have led to the distinction of third parts of metals, and metallick fractions which might express the ratio of proportion of metallick properties which each of these bodies appeared comparatively to possess. This supposition shows the falsity of the expression of semi-metals, for it shows, that while it is defective as a true term of comparison to express the proportion of the metallick properties, chymistry would admit an erroneous and ridiculous language, by supposing, that the metals might in that manner pass from one to the other conversion; a conversion, which art has never been able to effect, nor can it be shown by any observation, to have been effected in the processes of nature.

It is no less evident, that we may apply the same remarks to the words *imperfect metals*, which was adopted to denote such metals as easily lose their metallick properties, and could not be again reduced to the metallick state without the addition of some combustible substance. The same may be said of *perfect metals*, a name given to those whose calces (oxides) were reducible by the mere application of heat. This expression depends still more on the imaginary transmutation, than the former term of semi-metals; since they affirm a pretended perfection in the one, and an imperfection in the other, which supposes a power of coming to perfection, and arriving at the state of the former.

Rejecting, therefore, these hypothetical terms, infected with the opinions of the alchymists, and aware of the necessity of arranging the metals methodically, it became requisite, that distinctions should be admitted among them, derived from properties easily appreciated and compared with each other.

This is, however, by no means an easy task; for the relations of these bodies to the various objects of chymistry are so complex and diversified, that their classification becomes a matter of considerable difficulty; and we may safely assert, that no arrangement which has yet been made of these interesting bodies is wholly free from objection; nor do we pretend to introduce one, which has any peculiar claims to superiority in this respect, over those that are generally received among the chymists of the present day.

The celebrated French Chymist, Fourcroy, divides the metals into five orders, or classes. 1. The *brittle and acidifiable*, includes four species; viz. arsenic, tungsten, molybdena, and chrome. 2. The *brittle and simply oxydizable*, are seven; titanium, uranium, cobalt, nickel, (since shown by Richter not to belong to this division,) manganese, bismuth, antimony, and tellurium. 3. The metals that are *oxydizable and imperfectly ductile*, are mercury and zinc. 4. The *ductile and easily oxydizable*, tin, lead, iron, and copper. 5. The *very ductile, and difficult of oxydizement*, are silver, gold, and platina.

Another still more generally followed arrangement is that of Dr. Thomson, who divides them into four classes. The first class comprehends the MALLEABLE METALS, which are the following: gold, platina, silver, mercury, palladium, rhodium, iridium, osmium, copper, iron, nickel, tin, lead and zinc. The second class includes the BRITTLE AND EASILY FUSED; viz. bismuth, antimony, tellurium, and arsenic. The third class, metals that are BRITTLE AND DIFFICULTLY FUSED: these are cobalt, manganese, chrome, molybdena, uranium, and tungsten. The fourth class are termed REFRACTORY METALS, because they have never yet been exhibited in a separate form, but always in combination with oxygen. These are titanium, columbium, tantalium, cerium, and some others.

"By arranging metals," says Dr. Ure, "according to the degree in which they possess the obvious qualities of unalterability, by common agents, tenacity, and lustre, we also conciliate their most important chymical relations; namely, those to oxygen, chlorine, and iodine; since their metallick pre-eminence is, popularly speaking, inversely as their affinities for these dissolvents. In a strictly scientifick view, their habitudes with oxygen should perhaps be less regarded in their classification than with chlorine; for this element has the most energetick attractions for the metals. But on the other hand, oxygen, which forms one fifth of the atmospherick volume, and eight ninths of the aqueous mass, operates to a much greater extent among metallick bodies, and incessantly modifies their form both in nature and art." Now the arrangement we have adopted in the annexed list of these bodies, will indicate very nearly their relations to oxygen. As we progressively descend, the influence of that beautiful element progressively increases. Among the bodies near the top of the table, their powers are subjugated by the metallick constitution; but among those near the bottom, it exercises an almost despotick sway, which Volta's magical pile, directed by the genius of Davy, can only suspend for a season. The emancipated metal soon relapses under the dominion of oxygen.

The number of metals at present known amount to thirty, if we except the bases of the Alkalies and Earths, and one or two other substances, which some individuals wish to rank among these bodies; but as they are not generally acknowledged to belong to this class of substances, we shall not include them in the annexed table.

GENERAL TABLE OF THE METALS.

NAMES.	Specific Grav.	Precipitants.
1 Platinum...	21·47	Mar. Ammon.
2 Gold.....	19·30	Sulph. iron Nitr. mercury
3 Silver.....	10·45	Common salt
4 Palladium ..	11·8	Prus. Mercury
5 Mercury ...	13·6	Common salt Heat
6 Copper.....	8·9	Iron
7 Iron	7·7	Succin. soda, with perox.
8 Tin.....	7·29	Corr. sublimate
9 Lead.....	11·35	Sulph. soda
10 Nickel	8·4	Sulph. potash?
11 Cadmium...	8·6	Zinc
12 Zinc.....	6·9	Alk. carbonates
13 Bismuth....	9·88	Water
14 Antimony ..	6·70	Water Zinc
15 Manganese .	8·	Tartr. pot.
16 Cobalt	8·6	Alk. carbonates
17 Tellurium ..	6·115	Water Antimony
18 Arsenic	8·35? 5·76?	Nitr. lead
19 Chromium..	5·90	Do.
20 Molybdenum	8·6	Do.?
21 Tungsten...	17·4	Mur. lime?
22 Columbium .	5·6?	Zinc, or inf. galls
23 Selenium...	4·3?	Iron Sulphite amm.
24 Osmium....	?	Mercury
25 Rhodium ...	10·65	Zinc
26 Iridium	18·68	Do.?
27 Uranium ...	9·0	Ferropr. pot.
28 Titanium...	?	Inf. galls
29 Cerium	?	Oxal. amm.
30 Wodanium .	11·47	Zinc
31 Potassium ..	0·865	Mur. plat. Tart. acid.
32 Sodium	0.972	
33 Lithium....		
34 Calcium....		
35 Barium		
36 Strontium ..		
37 Magnesium.		
38 Yttrium		
39 Glucinum ..		
40 Aluminum..		
41 Thorinum ..		
42 Zirconium..		
43 Silicium....		

The first 12 metals in the table are malleable, as also the 31st, 32d, and 33d, in their solid or congealed state.

The first 16 are capable of being converted into oxides, which are neutral salifiable bases.

Those marked 17, 18, 19, 20, 21, 22, and 23, are capable of being acidified, by combination with oxygen.

Of the oxides of the rest to the 31st, very little is known.

The others form with oxygen, the alkaline and earthy bases.

Having given as full a list of the metals

as it is possible to obtain, and having stated pretty fully their general and characteristick properties, we shall now begin to describe them individually, and to state their particular properties. The malleable metals, being the most valuable, as well as the most useful, we shall begin by describing them first.

OF GOLD.

Gold seems to have been known from the very beginning of the world. Its properties and its scarcity have rendered it more valuable than any other metal.

It is of an orange red, or reddish yellow color, and has no perceptible taste or smell. Its lustre is considerable, yielding only to that of platinum, steel, silver, and mercury.

Its specifick gravity is 19·3.

No other substance is equal to it in ductility and malleability. It may be beaten out into leaves so thin, that one grain of gold will cover 56$\frac{3}{4}$ square inches. These leaves are only $\frac{1}{282000}$ of an inch thick. But the gold leaf with which silver wire is covered is only $\frac{1}{12}$ of that thickness. An ounce of gold, upon silver wire, is capable of being extended more than 1300 miles in length.

Its tenacity is considerable; though in this respect it yields to iron, copper, platinum, and silver. From the experiments of Sickengen, it appears that a gold wire 0·078 inch in diameter, is capable of supporting a weight of 150·7 lbs. avoirdupoise, without breaking.

It melts at 32° of Wedgewood's pyrometer.* When melted, it assumes a bright blueish green color. It expands in the act of fusion, and consequently contracts while becoming solid more than most metals; a circumstance which renders it less proper for casting into moulds.

It requires a very violent heat to volatilize it; it is therefore, to use a chymical term, exceedingly *fixed*. Gasto Claveus informs us, that he put an ounce of pure gold in an earthen vessel, into that part of a glass house furnace where the glass is kept constantly melted, and kept it in a state of fusion for two months, yet it did not lose the smallest portion of its weight. Kunkel relates a similar experiment attended with the same result; neither did gold lose any perceptible weight, after being exposed for some hours to the utmost heat of Mr. Parker's lens. Homberg, however, observed, that when a very small portion of gold is kept in a violent heat, part of it is volatilized. This observation was confirmed by Macquer, who observed the metal rising in fumes to the height of five or six inches, and attaching itself to a plate of silver, which it gilded very sensibly; and Mr. Lavoisier observed the very same thing when a piece of silver was held over gold melted by a fire blown by oxygen gas, which produces a much greater heat than common air.

After fusion, it is capable of assuming a crystalline form. Tillet and Mongez obtained it in short quadrangular pyramidal crystals.

Gold is not in the least altered by being kept exposed to the air; it does not even lose its lustre. Neither has water the smallest action upon it.

It is capable, however, of combining with oxygen, and even of undergoing combustion in particular circumstances. The resulting compound is an *oxide of gold*. Gold must be raised to a very high temperature before it is capable of abstracting oxygen from common air. It may be kept red hot almost any length of time without any such change. Homberg, however, observed, that when placed in the focus of Tschirnhaus's burning glass, a little of it was converted into a purple colored oxide; and the truth of his observations were confirmed by the subsequent experiments of Macquer with the very same burning-glass. But the portion of oxide formed in these trials is too small to admit of being examined. Electricity furnishes a method of oxydizing it in a greater quantity.

* According to the calculation of the Dijon academicians, it melts at 1298° Fahreinheit; according to Mortimer, at 1301°.

COMMUNICATION.] [FOR THE JOURNAL.

RAIL WAYS AND CANALS.

Next to Pennsylvania and New York, Ohio, notwithstanding she is denominated a new state, and less than half a century since was literally a wilderness, has made by far the greatest progress in the work of internal improvement.

The Ohio state canal, and Miami canal, were commenced at about the same time, and both of them are constructing on state account, exclusively.

The Ohio state canal extends from Cleaveland to Portsmouth, at the mouth of the Sciota, and connects Ohio River with lake Erie. Lake Erie is 568 feet above the Atlantick, and the Ohio River, at Portsmouth, is 474 feet. When completed, this canal will have 1168 feet of lockage. It was commenced at Cleaveland and Portsmouth, nearly at the same time. There is also a side cut leading to Columbus. According

to the report last January, this canal from the summit level at Licking, to Cleaveland, 190 miles was nearly finished, and it is now open and in active operation to Newark, 180 miles. The sum paid for constructing that part of the canal up to January, was $1,916,324—estimated sum for completing it $21,204. Its two navigable feeders cost $48,721 making the whole cost of that part of the canal $1,986,271. From Licking, to Portsmouth and Columbus, the side cut is under contract to be finished next summer. The whole amount paid on both divisions, up to January 1830, was $2,336,-367; and the commissioners estimate that $1,248,000 will be necessary for its completion, making a total of $3,584,367 equal to $11,200 per mile.

A direct tax of $300,000, to meet the interest on the amount already expended has been assessed, and this must probably be doubled ere the canal is finished, and an income realized from its tolls, equal to paying the interest on the outlay.

Still, a vast majority, not less probably than nine-tenths of the inhabitants of that state, bear this burden cheerfully, being well satisfied of what is undoubtedly the fact, that the increased prosperity which their efforts for internal improvement has produced has enabled them to pay the increase of taxes, with much more ease, than they could do their lighter burdens, before the canals were commenced.

The Miami and Dayton canal was finished from Cincinnati to Dayton 67 miles, and has been in complete and successful operation two years. It was intended in the outset to continue this canal through the state to lake Erie, near the mouth of the Maumee river. But the probability now is that it will be continued no further, and that a rail road for the remainder of the distance be substituted.

A canal is also in contemplation from the summit level, of the Ohio canal, to Warren, and from thence to the navigable waters of Bear river, 20 miles from its mouth, and about 40 from Pittsburgh, in Pennsylvania.

A grant has also been made by the Legislature of Ohio for a rail road from Wheeling to lake Erie.

The subject of internal improvement is already attracting considerable attention in the new states west of Ohio. In Illinois a canal to unite the navigable waters of the Illinois river with lake Michigan, at Chickago is contemplated. The natural situation of the country is extremely favorable for an easy and cheap construction. This would open a direct water communication between lake Michigan and New-Orleans.

In Michigan, a company has been formed, and a survey made for a rail road from Detroit to Pontiac, 25 miles, and from the enterprizing zeal now manifested, we may soon expect to see this project accomplished.

A canal is contemplated to unite the Fox and Ouisconsin rivers; this will open a water communication from Green Bay to the Mississippi River, and also from the Lead Mines on Fever River by the lakes to New York.

In Kentucky a company has been formed; stock to the amount of $600,000 subscribed; and first instalments paid for the construction of a rail road from Lexington to Frankford, thence to the Ohio River just below the Falls, a near shipping port; about 80 miles.

A Canal around the Falls of the Ohio has been some time under way, and it is still uncertain when it will be completed—$300,000 have already been expended.

The Maysville and Lexington Road is an undertaking of considerable magnitude; it is to be McAdamized at an expected cost of about $4000 per mile. This road, (in connexion with the proposed rail road, is expected to be of great importance to Lexington, as a communication by land through the city of Louisville,) will be opened much shorter than the present one by the river, so much so, as to offer a sufficient inducement for steam boat passengers from Pittsburgh for New Orleans to leave the boats at Maysville and resume them again at Louisville, a shipping port.

This enterprize is undertaken by a Joint Stock Company. The capital stock considered necessary for the completion of the work is 6000 shares of $100 each. 5496 shares have been subscribed. Four miles of this road are completed, and two more nearly so, at a cost considerably less than the original estimate, from which fact, as well as from other contracts already made, that estimate will be abundant to cover the entire expense of its completion.

This road is for the locomotive engine, exclusively. An engine has been built at New York and will be put upon the road as soon as the season will admit of the contractor going thither with it.

In Louisiana a rail road is now constructing by a Joint Stock Company, about five miles in length, from lake Pontchartrain

to New Orleans. The grading of this road is nearly finished, and the rails are expected from England in October or November. This is a single track, and is now expected to cost $15,000 per mile. Original estimate $13,000. Rails weighing 35 lbs. to the yard having been substituted for those of 11 lbs. as per first estimate.

In Georgia a canal is nearly completed from Savannah River, commencing at the west end of the city of Savannah, to the Ogochee River, 16 miles. It is expected that boats will commence running in October or November. It is also in contemplation to continue it to the Altamaha, about 60 miles. The route has been surveyed and a favorable report made. It is expected that the state will take a part in this enterprize.

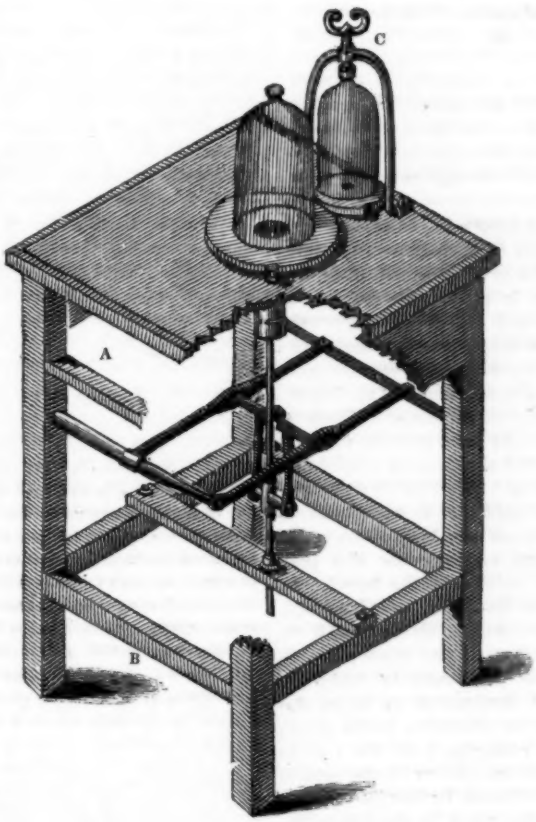
South Carolina has for some years been actively engaged in measures for internal improvement. The Winyaw canal, about ten miles in length, unites the Santee River with Winyaw Bay. Another of about the same length overcome the falls in the Wateree river, near Camden. The Santee canal, about 30 miles, unites the Congaree and Santee, and opens a water communication between Charleston and Columbia, and also Camden.

Steady progress is also making in the construction of a rail road from Charleston to Hamburgh, on the Savannah River, opposite Augusta. MIDDLESEX.

COMMUNICATION.] [FOR THE MAGAZINE.

AIR PUMP SIMPLIFIED,

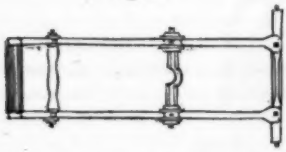
To be used both for Exhausting and Condensing. Made by Codman & Claxton.—Boston.



This pump may be used either for exhausting or condensing, and besides being useful for all the experiments with common air, it may be used for transferring gases from one vessel to another.

It consists, first, of a table made of mahogany, twenty-two inches square, with four legs resting on the floor; its height is several inches above that of the lecturing table; in the centre of the table a hole is cut, three inches diameter, for the admission of the pump barrel. The machinery of the pump is as follows: One barrel, two inches internal diameter, and eight and a half inches long; a ground brass plate, ten inches diameter, is attached to one end of the barrel,—this plate rests on the top of the table, and the barrel projects through the hole before described. The piston is worked by a lever of the second order, having its fulcrum in the back legs of the table; this lever is attached to the piston rod by two vibrating rods, which assists in preserving the piston and rod in a direct line, coincident with the centre of the barrel.

Fig. 2.



The lever and handle is shown in Fig. 2, part of it being hid in the perspective drawing. On the table another ground plate, five inches diameter, is placed by the side of the plate mentioned above; a brass tube passes from this small plate to the pump barrel, and is inserted just below the valve which is situated near the top of the barrel. This valve opens downwards. There is another valve in the tube opening towards the small plate, and the piston is a solid one without a valve.

The mode of operation is as follows.—Place a receiver on the large plate; depress the piston, and the air will pass through by the valve into the barrel. In raising the piston the air is forced through the tube, and by another valve, when it escapes at the centre of the small plate, so that exhausting is performed by using the large plate, and condensing by using the small one; and no alteration in the pump is necessary, in changing from the one to the other. There is a screw by the side of the large plate to admit the air into the receiver, and another screw by the side of the small plate to allow the condensed air to escape. One of the valves may be got at by unscrewing a brass piece in the centre of the large plate. The valve is attached to the under side of this brass piece. It is covered with a little cup to retain the oil, and keep the valve moist,—the other valve may be repaired by unscrewing the small plate. There is a cup screwed to the lower end of the barrel to prevent the oil from running down to the floor. The opening at A, Fig. 1, is for a drawer to contain the small articles used with the pump. It will be necessary to hang a weight of thirty or fifty pounds on the cross piece at B, this will keep the frame very steady. C is a bridle, with a screw, to hold down the condensing receiver.

SAFETY PUMP,

For detecting and removing the noxious gas found in wells. Invented by the Rev. J. F. Schroeder.

Having particularly examined into the advantages that may result from this improved pump, it being given to the world without an application for a patent, or any reward whatever, by its scientifick, ingenious and humane inventor, we cheerfully recommend it to the notice of our citizens. It may be useful for ventilating sick rooms, churches, and crowded assemblies, *by constantly pouring into them a current of fresh air*,* and expelling at the same time that which is impure and rendered unhealthy and offensive by being breathed through the lungs of the audience.

A new well, in the rear of Union Church, at the north-east corner of Orange and

* It has been found better to remove the noxious gas from wells, mines, sick rooms, &c. not by *forcing pure air into them*, but by *pumping out the foul air*, by placing the end of the inhaling pipe where the gas was most impure. In a well this pipe should extend to the bottom, (as it did in the present case;) but in a room the air is most impure at the top, of course it should be allowed to escape as high up as possible, by having the windows to slide from the top, or by an opening in the ceiling. In coal mines there are generally two kinds of noxious gases, carbonick acid gas (choke damp) at the bottom, and hydrogen gas (fire damp) at the top; the common air occupies the middle stratum. If only one pump is used to remove these, the inhaling pipe should have two branches, one terminating at the bottom and the other at the top of the mine; when the noxious air is removed, pure air will find its way by its *own gravity*.—Ed.]

Spring streets, in this [New York] city, was infected with a most deadly gas. On Friday, July 16th, a man attempting to descend into it, was instantaneously deprived of life; and a few moments afterward, another shared the same miserable fate, in an attempt to rescue his unfortunate companion. On the following Tuesday morning, the Rev. Mr. Schroeder, in company with some friends, visited the melancholy scene of the calamity. They found the well, by actual measurement, to be thirty-nine feet deep. On lowering a lighted candle into it, the flame, when it was six feet from the surface of the earth, was suddenly extinguished. Impure air, it was inferred, occupied the remaining space of thirty-three feet below.

The safety pump was placed on a bench near the mouth of the well; a conduit, attached to the inhaling pipe, extended to the bottom of the well; and another conduit, ten feet long, attached to the exhaling pipe, extended to an adjoining vacant lot of ground.

The pump was then worked. Some of the vitiated air was obtained in a glass receiver, placed at the end of the exhaling pipe, and by the application of the usual chymical tests, this vitiated air was proved to be carbonick acid gas, or what is commonly termed, choke damp.

The safety pump had been in operation for the space of seven minutes, when a lighted candle was again let down, and the flame was not extinguished until it had descended nearly twelve feet further than before. The safety pump was then worked again for ten minutes; and the candle being then let down to the very bottom of the well, burned with a clear flame. In seventeen minutes all the deadly gas had been entirely expelled.

This experiment was made before a company of gentlemen, one of whom, Dr. Stephen B. Whiting, after the above operation of the safety pump, went to the bottom of the well, and remained there for a time, without any injury or inconvenience.—(N. Y. Lancet.)

French method of preserving Butter.—The following improved process for the preservation of butter has lately been adopted in France:—Take one part of loaf sugar, one part of salt petre, and two parts of pure salt; mix and reduce them to a very fine powder. As soon as butter is perfectly worked, (to extract the buttermilk,) work into it one ounce of the above mixture to each pound, and pack it immediately, and as closely as possible, into pots, and smooth the tops over carefully, then cover the pots over with a fine linen cloth, and tie a piece of wet parchment (or bladder) over the whole. After a few days, it will be found that the butter has settled, and no longer fills the pots completely; they must then be filled up, taking care that no space be left; then pour over the top a small quantity of butter, melted to a low temperature; sprinkle over the surface a small quantity of the above mixture, and stop the pots as tight as possible, to exclude the atmospherick air. They should not be again opened until the butter is wanted for use. In this manner butter may be preserved for several years. It has been found at the end of two years to be as fine flavored as in the first month.

It should be remarked that butter prepared in this manner is not fit for use in less than a fortnight after being packed; by that time it will have acquired a very agreeable flavor, and so fresh that persons in the habit of eating salted butter, can hardly believe that it has ever been salted at all.

On opening the pots, care should be taken to use the top first, and not to cut down by the side. If all the butter contained in one pot be not used immediately, what remains should be covered with the same care as the first; or it may be kept covered with brine.

Butter may also be preserved by working into it a small portion of pure honey, which imparts to it a very agreeable flavor, and renders it very valuable for aged persons, and those who have weak stomachs. Butter preserved in this manner, has been kept for several years, and showed no tendency to become rancid. One ounce of honey to the pound.

We have received from a correspondent in Bruntingham, N. Y. the following sketch of a water wheel, with a disposition of the buckets different from any others that have come to our knowledge. We present it to the publick for consideration, according to the wish of the inventor.

We take it for granted, that the desiderata in overshot water wheels, are to receive in the buckets as much water, and to retain as much of it as possible, during the half revolution of the wheel; to discharge the water with ease; and then, that the rising empty buckets may be so arranged, as to

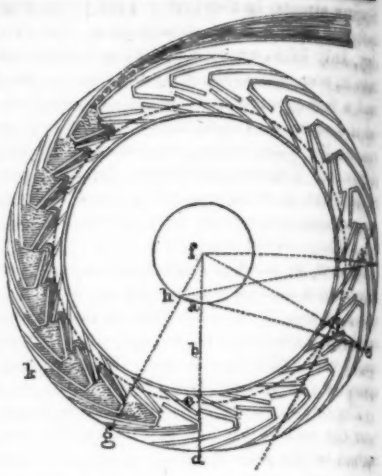
pass through the back water with as little resistance as is practicable.

It would appear by the plan, that this construction of buckets is calculated to retain more water than those buckets whose external parts are angular, these being segments of circles; and from the known principle in geometry, that a circle, of any given surrounding parts, will contain more than any angular figure which can be made from similar outlines. We do not remember to have seen any description of a water wheel embracing this principle.

It is not unfrequent that the air in the bottom of common buckets prevents them from receiving all the water which might otherwise enter, and has a tendency to throw a part of it out. To prevent this inconvenience, and to save the possible overplus, our inventor has detached the inner part of the bucket from the body of the wheel, leaving a space for the air first to pass out, and for the surplus water to follow into the next bucket. The depth of these buckets, the elevation of their external enclosure, and their curvilinear figure, would seem to prevent, in some degree, the water being thrown off also by the centrifugal force of the wheel. The free passage of air in the rear of the buckets must tend, we should think, to facilitate the discharge of the water, whether it be admitted from the first empty and ascending bucket, or its action be transmitted through the series of buckets, from the top of the wheel.

The circular shape of the external surface of the buckets must be more favorable to their passage through back water than any angular form, whose angle shall be equal to the chord of the segment in these buckets. And the suction, which carries up back water higher than its level by the rising empty buckets, when those buckets have no vent, is avoided in this by the free escape of air in the rear; and thus, the retarding force, from this cause is avoided.

In fine, we think that we see sufficient promise in this new form and disposition of buckets, to warrant an experiment; and wish our young correspondent success in his enterprize.



The radius is divided into four equal parts, as a, b, c, d; a, is a circle on which the leg of the compass is set to describe the front of the bucket; e, f, is at right-angles with f, g, on which, at the point h, the leg of the compass is set to describe the bucket e, i. The back of the bucket is formed by a tangent to the dotted circle.

COMMUNICATION.] [FOR THE MAGAZINE.

To build Stone Walls in deep water.

First, sound the bottom, and make your profile. When the ground is staked out, by driving a few small piles for guides, let stones from five, to ten feet in length, and of equal thickness, be whitewashed, if the water be clear, and then lowered, and cross piled, like wooden cob work, till they are above the tide, then fill the intervals with rough stones and proceed to build on this foundation, as the superstructure may require. Care should be taken to guard against inequality of hardness in the bottom; if this were very great, as was the case where the failures in the Boston wharves have occurred, it would be necessary to build on the soft places first, and carry the work high enough to force the first stratum down to a bearing, equal to the harder parts of the ground. This may be done, even if it were necessary to take up part of the stones (after they had procured the settlement) to tie the work together.

The same thing may be done in dirty water, by putting down guides, to mark off the spaces required, and removing these guides as you proceed.

GUNNERY IN THE EARLY AGES.

As mathematical knowledge increased in Europe, that of mechanicks gradually advanced, and enabled artists, by making brass cannon of a much smaller bore for iron bullets, and capable of bearing a much greater charge of strong powder in proportion to their calibers, to produce a very material and important change in the construction and fabrick of those original pieces.

The first pieces of artillery were rough and very inconvenient, being usually framed of several pieces of iron bars, fitted together lengthwise, and hooped with rings. These guns were first employed in throwing stone shot of a prodigious weight, in imitation of the ancient machines, to which they succeeded, and were of an enormous bore.—When Constantinople was besieged by Mahomet II. in the year 1453, the walls were battered with stone bullets, and some of the pieces were of 1200 lbs. caliber; but they could not be fired more than four times in twenty-four hours, and sometimes were burst by the first charge.

Guicciardin informs us, that about 114 years after the first use made of those unwieldy pieces by the Venetians, in their war against the Genoese in 1380, the French were able to procure, for the invasion of Italy, a great number of brass cannon, mounted on carriages, drawn by horses. He then enumerates the advantages which these pieces possessed, and particularly that they could be pointed with incredible quickness and expedition, in comparison with those formerly made use of in Italy. But, as our limits will not permit us to notice all the circumstances in connexion with these pieces, it is sufficient to remark, that this change in the formation of artillery has as yet undergone no material alteration; if we except the introduction of carronades, first suggested by General Melville, and of Columbiads, by the late Mr. Barlow.

Glenie (*History of Gunnery*, 1776) appears to have been the first, who gave the theory of projectiles in vacuo by plain geometry, or by means of the square and rhombus, with a method of reducing projections on inclined planes, whether elevated or depressed below the horizontal plane, to those which are made on the horizon.

Besides the formation of cannon, by uniting iron bars together, and strengthening them by hoops, (one or two of which were made in Philadelphia in 1776, by a Mr. Wheeler, of a superior kind,) others were made of thin sheets of iron, rolled up together and hooped; and on emergencies, they were made of leather, with plates of iron or copper. Stone balls were used, and a small quantity of powder. In the 13th century, cannon were used in a sea fight, between the king of Tunis and the Moorish king of Seville. The Venetians used cannon at the siege of Claudia Jessa, now called Chioggia, in 1366, which were brought thither by two Germans, with some powder and leaden balls; as likewise in their wars with the Genoese in 1379. At the battle of Cressy, in 1346, Edward III. made use of cannon. They were also employed in the seige of Calais, in 1347. Pieces of ordnance were made use of by the Turks, at the siege of Constantinople, then in possession of the Christians, in 1394, or in that of 1452, that threw a weight of 1006 lbs. Louis XII. had one cast at Tours, of the same size. One of those cannon was taken at the seige of Dieu, in 1546, by Don John de Castra, and is in the castle of St. Juliao de Barra, 10 miles from Lisbon. Its length is 20 feet 7 inches; diameter at the centre, 6 feet 3 inches, and it discharges a ball of 1000 lbs. It has neither dolphins, rings, nor buttons, is of a curious kind of metal, and has a large Indostan inscription upon it, by which it appears it was cast in 1400. The mortars at the Dardanelles are represented to throw shells, or ball of an immense size and weight.

Some do not consider cannon an European invention; because it is asserted, that authentick documents exist of their use in China, many centuries before they were thought of in Europe. If they say the testimony of the Chinese themselves is not sufficient on this point, the fact of their great wall being furnished with embrasures, fitted in such a manner for cannon, leaves no doubt of their having been in use at the time of its erection. To this an additional argument may be added, from their very ancient game of chess, in which pieces have been used from remote antiquity, designating engines of war, whose power was derived from gunpowder. Mr. Irvin, (*Trans. Royal Irish Academy*,) in his paper on the Chinese Game of Chess, proves, that gunpowder was in common use in China, 371 years after Confucius, or 160 years before Christ; and Du Halde has long since given documents to show, that the Chinese wall was in existence 200 years before the commencement of the Christian era; and con-

sequently, for the reason before stated, the use of cannon must have been of at least equal antiquity. The Asiatick Researches contain some remarks to the same point.—There is a strong probability then, that the invention of guns was of a much more remote date. It is not impossible, however, that the same thing may have been invented by different persons, in various parts of the world.

We mentioned, that it is much more probable, that the use of gunpowder in war was derived ultimately from the Chinese, notwithstanding the generally received opinion, that the Greek fire was the progenitor of its discovery; or that Bacon or Schwartz, an obscure monk, has claims to the invention. The mode in which the use of gunpowder in war might have passed from China to Europe, is the most probable and simple imaginable. Zingis Khan is known to have conquered the five northern provinces of China, about the year 1244. He must have known the common use of gunpowder at that period, as it had been known in China 1400 years before. In the *Chinese annals* of the Moguls, by Yuen, as translated by Pere Gaubil, it is particularly stated, that the use of cannon and mortars was familiar in the wars and sieges of Zingis against the Chinese, both by them and him, in attack and defence. It is most probable, that he used gunpowder in his wars against Mahomet, Sultan of Carisme, whose dominions extended from the Persian Gulf, to the borders of India and of Turkistan. It is known, that he had a body of Chinese engineers in his army, who, of course, must have been acquainted with the use of gunpowder.

The conquests of Zingis would thus have spread the knowledge of gunpowder, &c. over the western part of Asia; and the Europeans, in their crusades, may have had frequent opportunities of becoming acquainted with it. It was just after this time, that it became known, and was used in the European wars.

Sir Francis Bacon (*Moral and Political Essays,*) observes, that "ordnance was known in the city of Oxydraces, in India, and was that which the Macedonians called 'thunder, lightning, and magick;' and it is well known, that the use of ordnance had been common in China above two thousand years."

Beckman, (*History of Inventions*, iii, p. 434,) in his essay on the origin of guns and gun-locks, has given, at some length, the history of guns. All we can add here, is, that the first portable fire-arms were discharged by means of a match, which, in the course of time, was fastened to a cock, and afterwards a fire stone and steel plate were used. This fire stone was not a flint, but a compact pyrites, or marcasite, (sulphuret of iron,) which was distinguished by that name. On each new improvement, the piece received a new name; as, *buchse*, *haken buchse*, *arquebuse*, &c. After explaining the origin of these names, he adds, that the large pieces were conveyed on carriages, called *karrenbuchse*, but soon after also *canna*, cannon. Pistols are mentioned by Belay, in 1544, in the time of Francis I; and and under Henry II, the German horsemen were called *pistoliers*. The name is derived from Pistoia, in Tuscany; because they were there first made. Muskets received their name from the Latin *muschetus*, which signifies a male sparrow-hawk. They were first used at the siege of Rhege, in the year 1521. They were known in France in the time of Francis I. Brantome, however, asserts, that they were first introduced by the Duke of Alva, in 1567, and used in the Netherlands. He also says, that they were made general in France by M. de Strozzi, under Charles XI. The lock was invented in Germany, in the city of Nuremberg, in 1517; it is uncertain whether it is the present lock. In the arsenal at Hanover, there are many ancient pieces. The oldest had on the barrel, the figure of a hen with a musket in its mouth; because it is said they were made at Henneberg.

There are three species of cannon, the *gun*, the *howitzer*, and the *mortar*. The gun is the longest piece of artillery, employed at the present day: the *culverins*, *dragons*, &c. as they were formerly called, had calibers twice, and even three times as long as those now used. Guns were originally called *bombards*, and were eight calibers in length. The term *picriers*, from *pierre*, a stone, were given to some guns, because they were employed in throwing rough stones. The carronades, derived from the river Carron, in Scotland, where they were originally made, is a short gun, with a bore about eight diameters of the shot in length. The howitzer is a species of mortar, but longer, and used to throw a hollow projectile, called a howitz, which acts at first as a *richochet* ball. The mortar is the shortest species of cannon, and is used to throw bombs or shells. A stone mortar is used in sieges, to throw stones upon an enemy. Besides these de-

scriptions of guns, there is another division, to which General Lallemand (*Treatise on Artillery*, vol. 1, p. 20,) has given the name of *demi-guns*, under which he ranks the *harquebus* on a swivel, the *rampart gun*, and the *repeating gun*, or *musket*, of the Americans.

He observes, that the harquebus nearly resembles the *amusette* of Marshal Saxe, has a barrel like that of a musket, and carries a ball weighing half a pound or more; that the rampart gun, or wall piece, is a large musket, that was anciently much used in the defence of fortresses, having a barrel of 5½ or 6 feet long, and a ball from 10 to 14 to the pound; and that the repeating musket is a gun, consisting of seven barrels, all of which discharges 32 rounds in succession, making 224 in all. With respect to this gun, the effect of which we have witnessed, not only in the discharge of thirty-two rounds from a single gun, but the combined effect of seven or more barrels, the General observes, that the diameter of the bore is three-fourths of an inch, and the weight seventy pounds. It is placed, like the rampart guns, upon a wooden frame, and has a handle at the breech to point by. As to its use, he adds:—it may be advantageously employed in the defence of places at the moment of assault; it may be useful in the field, to defend parts of a line of battle, or entrenchments, with few troops, and yet astonish the enemy by a warm fire, when he ventures to approach. Its discharge does not last a minute. It may be of great service in the tops of ships of war.

The inventor is a Mr. Chambers, of Pennsylvania. Having examined their construction, and also the shot, it may be sufficient to remark, that the lead is cylindrical, one end being flat, and the other conical, and of such a size as to fit the calibre of the musket; that these rounds are pierced with a hole in the centre, which is charged with fuse composition; and after a charge of powder, one of these cylinders is put in; then a charge, then a cylinder, &c. up to 32. The lock is placed opposite the last charge, so that when the first load is discharged, the fire communicates successively *through the cylinders*.

We may add, that in 1764, M. Bouillet and Sons presented, to the Academy of Sciences, at Paris, a musket of their invention, which was lighter than the common kind, and had the property of firing twenty-four times in succession, charging and priming itself by a single circular movement of the musket upon an axis, fixed for that purpose. In the file of the *French Gazette*, for 1786, article Linberg, there is an account of an invention of the baron De Walskohl. It is the same, it would appear from the description, as the repeating musket. Being once charged it will fire thirty-six times in succession. The experiments made with it were satisfactory.

Many patents have been secured in this country, and in England and France, for improvements on the musket and rifle; but, in order to accommodate short-sighted persons, M. Regnier's invention appears to be the first, which consists in an *optick* glass fixed in the butt, enabling persons of that description to shoot with accuracy. This invention is given in the *Journal de la Blancherie* for 1779, p, 194.

In 1771, Moret, an armorer, announced a new constructed pistol, which would charge itself, &c.; and in 1793, M. Gass presented to the military committee of France, a pistol of a new construction, calculated to fire several balls in succession. The *Journal des Inventions et Decouv.* i. p. 121, speaking of this invention, adds, that the means employed depended entirely on the construction of the ball, which, instead of being round, was a cylinder, pierced in its length. This small canal is filled with meal-powder, and serves as the match of communication to the charges.

Mr. Misson (*Travels through Germany and Italy,*) says, that in the arsenal at Venice, there is an engine which will light five hundred matches at once, and some very curious arms of ancient make, among which is a small trunk, with six little guns, which Carrara, the last lord of Padua, who was famous for his inhumanity, sent as a present to a lady; and was so contrived, that, upon opening the trunk, the guns all fired at once, and killed her!

With respect to the invention of the various incendiary machines, we may observe generally, that Greek fire was employed in different ways, and was considered a destructive composition; that rain-fire, bombs, lances, matches, fire-balls and carcasses, torches, powder sacks, petards &c. were all employed in more modern times for the same purpose; and lastly, that the *fougette* of the Asiaticks, called Indian rockets, the Congreve rocket, the incendiary bomb of the French, and the floating rocket carcass, are embraced under the same head, and are all used for similar purposes in war,—(Cutbush's Pyrotechny.)

ALCOHOL;

The purely spirituous part of all liquors that have undergone the vinous fermentation, and derived from none but such as are susceptible of it. As a chymical agent, it is of the highest importance, involving in its various combinations all the grand principles of chymistry.—It has been found that spirit of wine, of sp. gr. .867, when enclosed in a bladder, and exposed for some time in the air, is converted into alcohol of sp. gr. .817, the water only escaping through the coats of the bladder.—Alcohol, obtained by slow and careful distillation, is a limpid, colorless liquid, of an agreeable smell, and a strong, pungent flavor. Its specifick gravity varies with its purity, the purest obtained by rectification over chloride of calcium being .791; as it usually occurs, it is .820 at 60°. If rendered as pure as possible by simple distillation, it can scarcely be obtained of a lower specifick gravity than .825 at 60°.—Mr. Hutton is said to have succeeded in freezing alcohol, but the fact is regarded as doubtful, as the means by which he effected its congelation were never disclosed. Mr. Walker exposed it to a temperature of 91°, but no congelation took place; it has, therefore, been much used in the construction of thermometers. Even when diluted with an equal weight of water, it requires a cold of 6° below 0 to congeal it. When of a specifick gravity of .825, it boils at the temperature of 176°, the barometrical pressure being 30 inches. In the vacuum of an air pump it boils at common temperatures. The specifick gravity of the vapor of alcohol, compared with atmospherick air, is 4.631.—Alcohol may be mixed in all proportions with water, and the specifick gravity of the mixture is greater than the mean of the two liquids, in consequence of a diminution of bulk that occurs on mixture.—The strength of such spiritous liquors as consist of little else than water and alcohol, is of course ascertained by their specifick gravity; and, for the purpose of levying duties upon them, this is ascertained by the hydrometer. But the only correct mode of ascertaining the specifick gravity of liquids, is by weighing them in a delicate balance against an equal volume of pure water, of a similar temperature.—Alcohol is extremely inflammable, and burns with a pale blue flame, scarcely visible in bright daylight. It occasions no fuliginous deposition upon substances held over it, and the products of its combustion are carbonick acid and water, the weight of the water considerably exceeding that of the alcohol consumed. According to Saussure, jun. 100 parts of alcohol afford, when burned, 136 parts of water. The steady and uniform heat, which it gives during combustion, makes it a valuable material for lamps.—The action between alcohol and some of the metals, particularly platinum, is remarkable. When a small piece of thin platinum leaf, suspended by a wire, is heated by a spirit lamp, and then quickly put into a glass, in which there is a little alcohol, so that it shall remain just over the surface, and of course in the vapor arising from the alcohol, it continues red-hot, as long as there is any fluid in the jar; which is owing to the vapor undergoing a sort of combustion, and generating heat sufficient to keep the metal in that state. This action affords the means of making a lamp without flame.—There are some substances which communicate color to the flame of alcohol; from boracic acid, it acquires a greenish yellow tint; nitre and the soluble salts of baryta cause it to burn yellow, and those of strontia give it a beautiful rose color; cupreous salts impart a fine green tinge.—Alcohol dissolves pure soda and potassa, but it does not act upon their carbonates; consequently, if the latter be mixed with alcohol containing water, the liquor separates into two portions, the upper being alcohol deprived, to a considerable extent, of water, and the lower the aqueous solution of the carbonate. The alcoholick solution of caustick potassa was known in old pharmacy under the name of *Van Helmont's tincture of tartar*. It is used for purifying potassa.—Alcohol dissolves the greater number of the acids. It absorbs many gaseous bodies. It dissolves the vegetable acids, the volatile oils, the resins, tan and extractive matter, and many of the soaps; the greater number of fixed oils are taken up by it in small quantities only, but some are dissolved largely.—(Enc. Americana.)

ON THE TEMPERING OF STEEL.

The processes invented for the tempering of steel have been so various and so inefficient, that it is of importance to select such as appear to have been attended with success. Among those which have enabled us to give to this operation a degree of certainty previously unknown, may be mentioned the baths of oil, or of a fusible metallick alloy.

Chymists in this country have made repeated experiments for the purpose of determining the degrees of temperature of all

the common oils in a state of ebullition, as well as those of the fusion of many metallick alloys composed of bismuth, lead and tin.

Those who adopt the use of metallick baths for tempering cutting instruments, ought to have them heated in vessels of cast iron, of different sizes and forms, according to the nature of the instruments to be tempered. It would be well to have two of them placed one against the other in the body of a register stove, to intercept at pleasure the communication of the fire, in order to be able to heat the one while the other is tempered. This method presents many advantages.

1. There is, by this means, no uncertainty as to the degree of temperature which ought to be given; for when once the operator has ascertained which of the metallick baths is adapted for the description of instruments that he wishes to temper, he has only to arrange them in a row upon the surface of the solid metal, and kindle a fire to make it melt; but great attention must be paid to remove all the instruments quickly, and to plunge them in cold water the moment the surface of the metal begins to liquefy, because they will then have all equally acquired the same temperature.

2. It is very difficult, not to say impossible, by the ancient method, to give the instruments an equal temperature throughout, when they happen to have thick backs; for frequently the blade is too hot, and even experiences alterations, before the other parts are sufficiently and regularly heated. The new process of metallick baths is of incalculable advantage for tempering large files and rasps, which must be left a very long time in the fire, before they become equally heated in all their parts. We are justified in saying that there are no instruments except the largest, such as plough-shares, planes, &c. that cannot be tempered with much more certainty by means of metallick baths, than by the methods formerly in use.

An opinion is pretty generally entertained, that, in the process of tempering, if the steel has been too much heated before immersion, it is necessary to give it a second time an excess of temperature, to bring it back to its proper degree of hardness, and that, unless this be done, a good cutting instrument cannot be made. This is, however, a very injudicious attempt to rectify one inconvenience by another; and a very little reflection will convince a thinking person that the method is altogether vicious, and has produced a great quantity of bad cutlery. It may be safely affirmed, *that the lowest possible temperature at which steel can be tempered, is indisputably the best*; and that to repeat the operation in any manner, must essentially affect its principal properties.

In fact, steel which has undergone too strong a temperature, rarefies, and has neither a fine nor a compact grain. It is so susceptible of alteration at the least degree of heat, that, if ever so slightly exposed to it, its cutting qualities are injured. It will be evident from these observations, that no degree of temperature can restore to steel which has once been over-heated, the properties it has lost. Notwithstanding this, many workmen perform this very delicate operation without any attention, with the idea that they can always repair their negligence by the improper method we have already mentioned.—(Ann. de la Soc. d'Agr.)

FRANCONIA IRON WORKS.

The Franconia iron works are situated upon the south branch of the lower Ammonoosuck, which empties into the Connecticut River at Bath, sixteen miles distant; and are seventy-five miles north-west from Concord, the capital of the state, one hundred miles west from Portland, (Me.) and one hundred and forty north north-west from Boston. There are two manufactories; the New Hampshire Iron Manufactory Company, and the Upper works,—formerly, the Haverhill and Franconia Iron works. The first of these is situated in the village of Franconia, and the second, one mile above. The ore is nearly four miles distant from both, and costs them, delivered at their works $4,75 per ton: the price of raising and picking it, being $4, the ton, and its carting from the mountain the remainder. It yields fifty per cent. pig iron, and thirty three per cent. bar iron. They manufacture at present, three hundred tons of bar iron, and three hundred, or three hundred and fifty tons of cast iron, annually; the largest part of which is required for the consumption of the neighboring country, and the remainder goes, either over land or by water to Boston,—the transportation by land, being $25 per ton, and down the Connecticut by water, $12 per ton. Bar iron is worth at Franconia $112 per ton, and pig iron $40 per ton.

The works of the New Hampshire Iron Manufactory Company form much the largest establishment, consisting of a Blast Fur-

nace, Forge, Trip Hammer, Shop and Mills. It employs sixty men in the various departments of mining, coaling, smelting, and forging, the operations of the trip hammer shop and mills, farming, &c. Their furnace which is like those employed in the great iron mines of Sweden, is thirty feet in height, of an ovoidal form, and furnished with a powerful cylindrical machine for giving the blast. It is lined with a white granite from Landaff, composed principally of felspar, which the iron master assured us, formed a very durable and excellent lining. The furnace was heating up, at the time of our visit, for an operation to last eighteen weeks.

Captain Putnam, the enterprizing agent of this establishment, informed us, that their manufactures for the last nine years had annually averaged forty tons of bar iron, and two hundred and sixteen tons of cast iron, in hollow ware, stoves, machinery, and pig iron; with the yearly consumption of two hundred thousand bushels of charcoal, which costs them $3,75 per one hundred bushels. But in consequence of considerable improvements in their works which were just completed, they were beginning to manufacture at the rate of two hundred tons of bar iron, and from three hundred to three hundred and fifty tons of cast iron, annually.

The upper works are at present, individual property; being owned and superintended by Mr. J. Richardson. He manufactures bar iron only; and produces one hundred tons annually. This gentleman does not employ the high furnace for the reduction of his ore; but the more simple apparatus of the Catalan forge; which although it requires more charcoal, yet yields excellent wrought iron, and requires comparatively but a moderate capital. The ore after a slight roasting, and reduction in the crushing mill, is thrown, every few minutes, by the shovel full (without any flux) upon the burning charcoal of the forge hearth, to which the blast is given from two cylindrick machines, five feet long and three feet in diameter; the pistons are worked by cranks and pitmen. When a loup or cake of sufficient size has been accumulated in the basin of the forge, it is withdrawn, put under the hammer and forged at once. Thus, both the forge and furnace operations are united in one. These works consume seventy thousand bushels of coal annually, at an expense of four dollars the one hundred bushels; and furnishes employment for twenty men.—(Prof. Silliman's Journal.)

Compound Linseed Oil, &c. for Painters' use.—Among the many new discoveries and new machines to which the science and inventive genius of our countrymen are constantly giving birth, there is seldom one which promises more real and extensive utility to the publick or greater benefit to individuals, than a method of "*Compounding Linseed Oil, for Painters' use*," recently discovered and patented by Mr. John G. Pendergast, of this village.—One important advantage of this composition is, that it requires only one half the usual quantity of oil, (the most expensive article used in painting, and which must continue to become more scarce as the use of cotton supersedes that of flax,) while the quality and properties of the paint are improved in some important respects. It may be used in all colors with equal advantage, is perfectly impervious to water, and has, when mixed with colors, so exactly the appearance of paint mixed in the ordinary way as to deceive the most experienced painters; it works freely and handsomely under the brush, drys well and with a tough skin, and cannot be distinguished, after having been used, from paint prepared as formerly. Painting done with this compound may be finished with or without gloss; it has a natural tendency to gloss, but this can be counteracted by using spirits of turpentine, for which it has an affinity, and with which it works perfectly free.

The patentee has exhibited his improvement in the cities of Washington, Baltimore, Philadelphia, New Brunswick, Newburgh, Catskill, Albany, Schenectady, and all the places of importance along the line of the canal as far as Rochester, to the most experienced painters, and has not failed in any case to make a sale.

We understand it has been sufficiently tested in this village, and is ready at all times for the inspection of the curious, and those wishing to avail themselves of its benefits.—(Western Spectator, Palmyra, N.Y.)

Combustion of Ashes.—Perhaps but few people are acquainted with the fact, that ashes made by burning hard wood, such as walnut or maple, and taken up dry, are capable of producing spontaneous combustion, simply by receiving a degree of moisture, or by coming in contact with a wet board, or being exposed to a damp atmosphere. It is generally believed when fire is kindled by ashes, that it is caused by coal being put away with the ashes while on fire: but this is an entire mistake. The coals, if on fire when they were buried in ashes, and excluded from atmospherick air, would soon be extinguished; or if they were not, they could not kindle a fire when the air was excluded.

The spontaneous combustion of ashes proceeds from a very different principle. Hard wood ashes when first made, and while they are kept dry, contain *potassium*, which

is the basis of potash. This metal is very combustible, and has a strong affinity for oxygen, which it extracts from the water the moment it touches it, and burns with a vivid flame. The product of this combustion is *potash*—that is, potassium saturated with oxygen, or what may be called *the oxide of potassium*. It should be noticed also that water is a compound of oxygen and hydrogen, and that when the potassium comes in contact with the water, it takes the oxygen from it, and the hydrogen being set free increases the combustion.

The simple fact then is this: dry ashes, when first burnt, contain in them a metallick substance which is highly inflammable, and which is set on fire by moisture.

Quick lime and water produce heat, sufficient in some instances to set wood on fire; but ashes and water produce a much more intense heat. In adding water to lime, much heat is evolved but no real combustion is produced; but in adding water to ashes, there is a real combustion of the metal contained in the ashes—the metal being a combustible substance, requiring nothing but the oxygen of the water to set it on fire.—(Western Spectator.)

Extraordinary descent in a Diving Bell.—An attempt is now making to raise the sloop Detroit, of Albany, which was run foul of and sunk on the 22nd of April last, in the channel of the Highlands, opposite West Point, with a cargo estimated to be worth $25,000. By means of the diving bell, chains have been placed under her, forward and aft, which, when properly connected, are to be used in raising her. The weight to be raised is estimated at from one hundred to one hundred and twenty tons. Mr. John Blair, who has frequently descended in the diving bell in various parts of the United States, has on this occasion far exceeded any undertaking of the kind on record. He descended several times to the bed of the river, being a depth of *one hundred and eighty feet*, where he remained on one occasion, something more than three quarters of an hour. The pressure he experienced was so great, that when drawn up, it was found necessary to place him in a warm bed for several hours, before he was sufficiently restored to converse. The bell is made of black walnut, about two and a half feet diameter at the upper part, by seven feet at the base, and about six feet in height; strongly secured with iron hoops, and loaded at the lower flange with pig iron, secured to the rim by canvass bandage. It is perfectly simple in its construction, and unprovided with the means of deriving any supply of air, other than that contained within it, when first let down upon the water. When drawn up it could be distinguished several feet below the surface of the water, from the hissing (or *singing* noise, as the attendants expressed it,) which the confined air produced through the pores of the wood. It is altogether one of the most unexampled descents ever attempted in this or any other country.—(The Age.)

Bug in the Ear.—On Monday evening last, a young lad, grandson of Mr. Abraham Price, Innkeeper of this city, [Troy] having laid down and fallen asleep in the bar room suddenly awoke in excessive agony, from peculiarly painful sensations in the ear. The customary methods of relief, such as filling the ear with spirits, stimulating oil, &c. were resorted to, without effect. The anguish which the boy appeared to endure continually increased, until fears were entertained that he would become distracted.

Dr. Brown was called upon for medical aid, and he, by examination, ascertained that a black bug, apparently very large, had penetrated the external opening of the ear, till he had reached the tympanum. It seemed as if he filled up the cavity so completely that the fluids poured into the ear could not pass him, or that by his exertions he had wedged himself in so closely that he was unable to get back. Attempts were made to extract him with common forceps, and also with a small scoop, but without success. On the slightest touch the animal would move, which occasioned excessive torture. At length, with a very slender pointed forceps, he was with some difficulty drawn out. He measured ⅜ of an inch in length, and in circumference was about the size of a large writing quill.—(Budget.)

"*Spontaneous Combustion.*—A correspondent of the Troy Sentinel, relates the occurence of several cases of spontaneous combustion. His statement being brief, we extract it, as important to those engaged in caulking or repairing ships.

While repairing the tow boats, large quantities of pitch and rosin are used, mixed with a quantity of coarse whale oil, to pay the seams and decks.

The kettle used is carried remote from the fire: the workmen apply this hot cement with a small mop made of woollen yarn. In one instance the mop took fire while in the hands of the workmen; in two instances they took fire lying on deck; and in another, the mop was placed against a pile of boards, when the men went to breakfast, in about half an hour the mop took fire from spontaneous combustion, and communicated fire to the pile of boards: considerable exertion was necessary to extinguish the flames."

Dioptra.—If you wish to find any thing that is lost in a well, or to ascertain the cause of any impurity there may be in the water, place a common mirror over the well in such a position as to catch, and throw

the rays of the sun directly to the bottom of the well, which will instantly become illuminated in a manner so brilliant that not only the smallest articles, such as pins, needles, spoons, knives, &c. can be distinctly discerned, but also, that the smallest pebbles and stones at the bottom can be as effectually examined as if they were held in the hand. The sun is in the best situation to be reflected in the above manner, in the morning or afternoon of the day.—(Hampden Whig.)

To remove a Tight Stopper from a Decanter.—It frequently happens that the stopper of a glass bottle or decanter, becomes fixed in its place so firmly, that the exertion of force sufficient to withdraw it would endanger the vessel. In this case, if a cloth wetted with hot water, be applied to the neck of the bottle, the glass will expand, and the neck will be enlarged so as to allow the stopper to be easily withdrawn.—(Cabinet Cyclopœdia.)

[A better, and much more cleanly way of accomplishing the above object, is to encircle the flame of a lamp, or candle, with the thumb and forefinger, till the heat can be borne no longer, and immediately remove your hand to the neck of the bottle, which must be grasped gently, and in a few moments the stopper may be drawn with all possible ease.—Ed.]

Alkanet, (a dyeing drug, the bark of a root which produces a rough plant with downy and spear-shaped leaves, and clusters of small, purple or reddish flowers, the stamens of which are shorter than the corolla,) imparts a fine deep red color to all unctuous substances, and to spirit of wine. It tinges water with a dull, brownish hue. Its chief use is for the coloring of oils, plasters, lip-salve, and other similar articles. It is likewise employed in compositions for rubbing and giving color to mahogany furniture. Wax, tinged with Alkanet, and applied to the surface of warm marble, stains it flesh color, and sinks deep into the stone.

COMMUNICATION.] [FOR THE MAGAZINE.

Mr. Editor.—As you seem to take some interest in the subject of an inquiry which I inserted in the July number of your Journal, I have determined not to be satisfied with the "*half loaf*"—if I can get the other half,—which your correspondent "X. Y. Z." has kindly furnished in your last, and with your permission, will propose to him, a few questions upon points which I most wished to be informed upon, with a respectful request that he will answer them, as he appears to be fully capable of doing it.

Does oil or tallow unite with alkali in definite proportions? And if so, may not soap be properly called a salt? Does a *mechanical and a chemical* combination take place in mixing fat with ley? If both, at what stage of the process, does the mechanical combination commence? Can soap lose the water, *chemically* combined with it, by evaporation, or shrinkage? And if not, what per cent. of water does it contain?

G.

COMMUNICATIONS.] [FOR THE MAGAZINE.

How to prevent Iron Rails from drawing out of the Posts from contraction by Frost, and to remedy the contraction of Iron Tubes.

Let the rails, somewhere about midway between the posts, be lapped and confined by two flat bands encompassing them, they will thus have liberty to contract or expand without drawing out of the posts.

Iron tubes, for gas, or water, which are exposed to contraction and expansion, may be allowed that liberty, by uniting them at such intervals as the known contraction may require, by two circular and slightly convex plates, or disks, united at their edges, and the tubes attached by flanches, to holes in the centres of those two plates, which will approach, or recede from each other, as the tubes contract, or expand. I have heard that the pipes in the city of London, occasion much difficulty for the want of a remedy to this propensity.

X.

PILE DRIVING.

I believe I had the honor of first proposing to apply the tread wheel to the driving machine, while the Boston and Roxbury mill dam was building, and published some little notice of the thing at that time. When a greater power is required, for a short effort, than can be obtained from the weight of the men, the power may be doubled, by having a strap over their shoulders, and hooked to the floor. They can thus work for a short time, with their weight and strength united.

Y.

Quere.—Which will drive most, in a pile driving machine, a piece of oak fifteen feet long, weighing 500 lbs. and the lower end hoisted as high as the common hammer, or the common iron hammer of the same weight? I fear that mathematical precision alone, will not give an answer, altogether conformable with facts.

Z.